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The recognition of declarative questions in information dialogues

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The Recognition of Declarative Questions in Information Dialogues

Robbert-Jan Beun

The Recognition of Declarative Questions in Information Dialogues

Proefschrift

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*“Ich hätte gerne ein gutes Buch hervorgebracht.
Es ist nicht so ausgefallen; aber die Zeit ist vorbei,
in der es von mir verbessert werden könnte.”*

Ludwig Wittgenstein: Philosophische Untersuchungen.

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Chapter 1

Introduction

1.1 Goal of this thesis

To indicate the question function of an utterance in natural dialogue, a speaker may use different cues. For instance, the utterance may begin with a WH-word (where, what, how, etc.) or an auxiliary verb (did, can, are, etc.) to indicate a WH-question or a Yes/No-question; this is exemplified in (1) and (2), respectively.

(1) “What is a declarative question?”

(2) “Is this a declarative question?”

In such cases, the question function can be determined from syntactic cues. When natural dialogues are actually examined, however, one may notice that many questions asked in dialogues have the syntactic form of a statement, and do not possess one of the overt cues mentioned above. These questions will be called *Declarative Questions* (DQs). In example (3), the question function of a DQ is indicated by a question-mark, which, in spoken dialogues, may correspond with a rising intonation.

(3) “This is a declarative question?”

In natural dialogues, however, a DQ often lacks the final rise in intonation and, although hearers usually have no problem in understanding its question function, it is unknown which cues are used to disclose the function of the DQ.

The primary goal in this thesis is to recover how listeners in natural dialogues identify the question function of a DQ and which information is conveyed by the speaker if a declarative form is used instead of an

interrogative one. More specifically, we will be concerned with the identification of the mental state of a speaker in terms of beliefs and intentions from the linguistic features (prosodic and textual) and the circumstances (context) of the DQ. For that, we have opted for a combination of empirical observations, experiments, and a theoretical approach: empirical since we want to know what is actually going on in real discourse, experimental to manipulate the circumstances and to test the hypotheses that come from the empirical observations, and finally theoretical to model the identification process of the communicative function of an utterance and to develop formal methods suitable for use in computer dialogue systems.

The present research is primarily aimed at the field of *speech act theory* (Austin (1962); Searle (1969)), although it has gained much from methods used in different fields of linguistics, such as psycholinguistics and conversational analyses. In speech act theory, the use of language is viewed as the performance of actions by a speaker to change certain aspects of the world. Examples of such actions are 'stating', 'warning', 'questioning', 'promising', etc. In this thesis, speech acts will be considered as special instances of *communicative acts*, i.e. acts that are intentionally meant to transfer certain (linguistic) information. For historical reasons only, we will keep the term 'speech act' here; in chapter 6, however, the term 'speech act' will be replaced by 'communicative act' to refer explicitly to the conception of an act as a context-changing function (Gazdar (1981); Bunt (1989a)).

So, the empirical and experimental results will be used to support a better understanding of speech acts, especially the relation between form and function (here: 'declarative' and 'question', respectively) of the utterance in natural dialogue. This presupposes, for instance, that mental states should not be conceived primarily as states in a psychological sense but rather as logical concepts, with logical interrelations expressed in axiom schemes and rules of inference, to describe the conditions that must be fulfilled to perform a certain speech act.

To distinguish the syntactic form from the function of the utterance, we will use the syntactic features *declarative* and *interrogative* as opposed to the function names *statement* and *question*, respectively. It will be presupposed that the notion of 'declarative' as a syntactic device is

intuitively clear; no effort will be made to describe the morpho-syntactic characteristics of the declarative as opposed to other sentence types, such as interrogative, imperative or exclamative.

1.2 Information dialogues

The type of conversation considered in the present research is restricted to dialogues. A dialogue in this thesis will be viewed as a real-time exchange of information between two participants by means of linguistic tokens. By 'real-time' we mean that the time between two consecutive turns is relatively short, usually no longer than a few minutes. This also includes keyboard dialogues, where people sometimes take somewhat longer time to respond to their partner (see e.g., Beun & Bunt (1987)).

Here, the type of dialogue will be restricted to so-called *information dialogues*. In information dialogues, participants behave in a rational and cooperative way and have the sole purpose of transferring factual information (Bunt (1989b)). Examples are dialogues with information desks of airport services, railway stations and task-oriented dialogues such as described in Grosz and Sidner (1986). The motivation for choosing this type of dialogue is twofold:

"The scientific reason is that virtually any kind of dialogue depends on the transfer of information. The study of information dialogues is therefore basic to the study of dialogues in general. The practical reason is that dialogues, purely motivated by the aim of transferring factual information, are one of the most obvious forms of communication in natural language that make sense with a computer." (Bunt (1989b): pp. 423)

It was already mentioned that we want to know what is going on in real discourse. Hence, we want to analyse utterances that people normally use in the circumstances of an information dialogue rather than made-up examples emanated from the investigator's intuition. Taking material from real-life dialogues has two other major advantages. Firstly, the problem of circularity can be avoided. That is, on the one hand we would like to determine the question function from the characteristics of the utterance and, on the other, we want to find out which characteristics are important in determining the function. Since the function can be derived from

the discourse, we can simply pick out those utterances with a declarative sentence type that function as questions in the dialogues, without bothering beforehand about their characteristics. Secondly, contextual information usually plays an essential role in determining the question function; the dialogues (discourse and non-discourse context) enable us to determine what this information may be.

The dialogues considered in this thesis were taken from a laboratory experiment where subjects had to determine by telephone departure and arrival times of aircraft and trains from an informant at Schiphol airport (Beun (1985)). Before we give a short overview of the research in the next section, an example of the kind of investigated dialogue is shown in (4).¹ Note that the italicized utterances in lines 8, 10 and 15 are declarative questions and easily identifiable as such from the discourse although no question-marks were added.

(4) I = information service, S = subject

1 I: Schiphol Information.

2 S: Good afternoon. This is van I. in Eindhoven. I
would like to have some information about flights to
Munich. When can I fly there between now and next
Sunday?

3 I: Let me have a look. Just a moment.

4 S: Yes.

5 I: O.K., there are three flights every day, one at
nine fifty,

6 S: Yes.

7 I: one at one forty and one at six twenty-five.

8 S: Six twenty-five. *These all go to Munich*

9 I: These all go to Munich.

10 S: *And that's on Saturday too*

11 I: And that's on Saturday too, yes.

¹The example is taken from Bunt (1989b); the English translation is a junction of different dialogues and used to accentuate the occurrence of declarative questions in this type of dialogue. The original Dutch transcriptions have been collected in Prüst, Minnen & Beun (1984).

- 12 S: Right. Do you also have information about the connections to Schiphol by train?
- 13 I: Yes, I do.
- 14 S: Do you know how long the train ride takes to Schiphol?
- 15 I: *You are travelling from Eindhoven*
- 16 S: That's right.
- 17 I: It's nearly two hours to Amsterdam. You can change there and then it's another fifteen minutes, so you should count on some two and a half hours.
- 18 S: O.K. Thank you.
- 19 I: You're welcome.
- 20 S: Bye.
- 21 I: Bye.

1.3 Thesis outline

In the next chapter, we will concentrate on certain issues about the identification of speech acts and communicative acts in general. Uttering sentences will be viewed as the intentional performance of actions to achieve a certain goal of the speaker. To some extent, communication is based on the notion of conventionality, i.e. a listener may infer from certain conventional syntactic or semantic structures of the utterance the function of the utterance. Also, a speaker may use mutually known protocols applied to cooperative dialogues to communicate information (e.g., the cooperation principle as formulated by Grice (1975)). From the identification of communicative acts in general, we will descend to the more specific case of the identification of questions.

In the following chapters we will concentrate on declarative questions. In chapter 3, two experiments are described where subjects had to identify the question function from tape-recorded utterances. The first experiment was an exploratory investigation to give an impression of the main characteristics of DQs. DQs, isolated from the earlier recorded telephone dialogues, were mixed with isolated answers from the same

dialogues. In the second experiment, potential question indicators of the DQs were removed by computer and the original and edited utterances were both presented to the subjects so that the influence of the removal of these indicators could be investigated.

A disadvantage of removing textual indicators from the speech signal is that prosodic features are removed as well. To eliminate prosodic characteristics and to concentrate on textual indicators only, an experiment is described in chapter 4 where the subjects had to identify a DQ from screen. In contrast with the previous experiments, the responses of the subjects could not be directly compared with real-life utterances, since the utterances were only based on the declarative questions from the original dialogues.

In chapter 5, an experiment is described where the influence of contextual features was tested on the use of DQs in a dialogue situation. Dialogues, taken from transcriptions of the earlier conversations, were presented on paper to subjects and information with respect to the semantic content of the questions was manipulated in three ways: 1. the information could be derived from the previous text literally or by implication, 2. the information was derivable from pragmatic inferences (implicatures) or 3. the information was not derivable at all from the previous text. In the experiment, one group of subjects had to indicate preference for a declarative or an interrogative form of the question; another group had to judge the speaker's certainty about the semantic content of the declarative.

In chapter 6, a theoretical framework is sketched to identify the beliefs and intentions of a speaker from the linguistic features of the utterance. The framework is based on an application of hierarchically ordered default rules. By such rules, a preferred interpretation of an utterance can be given in terms of relevant aspects of the mental state of the speaker. A preferred interpretation can be rejected in cases of inconsistency due to contextual knowledge of the hearer. In those cases, a hearer may turn to a less preferred interpretation. For instance, a declarative is interpreted as a statement unless contextual evidence says otherwise. In the latter case, a declarative may be interpreted as a question, or, more specifically, a verification. The framework was worked out in such a manner that contextual information and some results of the experiments could

be incorporated.

Chapter 2

The identification of mental states

2.1 Introduction

Since speech acts are considered as instances of communicative acts (CAs), they will also inherit characteristics from CAs. Here, CAs will be considered as actions intentionally performed to transfer certain information from an actor (speaker) to an observer (hearer) and as parts of a plan to change certain aspects of the world. For instance, if an actor wants to make inquiries by phone about the departure time of his plane to San Francisco, he has to develop a plan to obtain the relevant information. The plan consists of a number of actions some of which may be communicative: he has to find out the right phone number, call the information desk, talk to the informant, etc. (see e.g., Pollack (1989)).

Intentions play a fundamental role in human communication. Not only are CAs intentionally performed to transfer certain information, CAs are also performed in the Gricean sense of *non-natural meaning* (meaning-nn: Grice (1957)), i.e.:

An actor meant-nn α by doing a certain CA iff:
the actor intended the CA to cause some effect α in the
observer by means of the recognition of that intention.

So, the action of scratching your nose may be performed intentionally to relieve the itch; however, only when the action is intentionally performed to cause a certain effect in the observer by recognizing that intention will we speak of the (non-natural) meaning of a certain action. For instance, in a card game, if the scratching is performed to cause the effect that the observer knows that the actor has a good card, the meaning of the

scratching is the intention that the observer recognizes that the action is performed to communicate that the actor has a good card.

Now, an important question to be answered is how the observable features of the CA (such as body movements, words, etc.) can be related to aspects of the actor's mental state. In other words, how does an observer recognize from the actor's behaviour the intended information transfer? Here, we have two options. Firstly, the observer may infer relevant parts of the actor's mental state from knowledge of a *convention* that a particular behaviour has a certain meaning. In that case, the meaning can be derived from the behaviour itself. Secondly, the meaning of someone's behaviour can be inferred from *situational* characteristics. The same behaviour may have different meanings in different situations and, on the other hand, different behaviour may have the same meaning in the same situation. For instance, the act of raising a hand may count as a 'greeting' in one context, and an 'appeal for help' in another. And the act of pointing at the salt cellar may have the same meaning in the same context as asking "Can you pass me the salt?". So, to derive the intended information transfer from an actor's behaviour, we have to describe at least (1) the actor's behaviour, (2) conventions regarding the meaning of a certain behaviour and (3) particular contextual aspects.

To infer the meaning of a certain act, we will concentrate in this chapter on both the behaviour of the actor and some contextual constraints. Since we only consider actions that are intentionally performed, we will first discuss how intentions should be understood in this thesis. Next, we will elucidate what we mean by the concepts of cooperation and rationality. And finally, we will narrow the type of act to linguistic acts and focus attention on speech act theory. In particular we will discuss various features that may support a question interpretation of the utterance. The features of the act in terms of prosodics, lexical items and sentence structure of the utterance may be conceived as a particular behaviour of the actor. Rules of cooperation and rationality are supposed to be perennial information and may therefore be understood as contextual knowledge of the actor.

2.2 Intentions

In both Allwood (1976) and Bratman (1989), a distinction is made between intentions that are connected to actions and intentions that are connected to mental states. For instance, an agent may intentionally pick up the phone and he may have the intention to be in San Francisco in the future. In the former case the intention characterizes the action, i.e. the action is purposefully performed to achieve a certain state. In the latter case, the intention characterizes the agent's mental state, i.e. the agent's commitment to achieve a certain desired world. What is important here is that the first intention indicates that the action is part of a plan to achieve an intended state and that the second intention can be considered as a conduct-controlling attitude to direct behaviour towards a certain end. In what follows, we will mainly be concerned with the latter, although it will be assumed that all actions considered in this thesis are performed intentionally.

Intention should be carefully distinguished from *consciousness* and *desires* of an actor. We will assume that some actions that are part of a plan may be carried out consciously, other actions less so or even unconsciously. However, all actions are carried out intentionally and are therefore part of a plan to achieve an intended state. For instance, the actor does not have to be conscious of the way he picks up the phone or how to move his fingers to dial the number, although these actions are carried out intentionally, i.e. to achieve the primary goal to know the departure time of the plane. In the same way a speaker is not conscious of the way he pronounces words or how he 'adds' certain intonation patterns to his utterances, although the utterances are performed intentionally. We will assume that the identification of someone's intentions does not depend on his consciousness.

Cohen & Levesque (1989a) argue that intentions are related to desires of an agent but are not reducible to them. An agent may have competing desires; intentions, by contrast, are always consistent, i.e. an agent believes that the state resulting from the performance of his intended actions is a reachable state. For instance, the agent cannot have the intention to be at two different places at the same time. However, an agent may have the desire to be at both places at the same time. Loosely

speaking, an agent chooses a certain desired state and his decision commits him to execute certain actions to achieve that state. In other words, intentions make the actor act. Henceforward, we will call the final state to be achieved the *basic intention* of the actor.

2.3 Cooperative behaviour and intentions

The basic intention of an agent, which corresponds with the intended final result of the agent's plan, is usually difficult to discover. A hearer may recognize the basic intention if a speaker expresses himself extremely precisely or completely (which hardly ever happens in conversations) or when the context is sufficiently restrictive to recognize the intention (e.g., when two people know each other very well). Fortunately, the basic intention need not be recognized in most cases. Let us take an example to clarify this.

In a dialogue with an information desk at Amsterdam airport, the information seeker asks what time the plane leaves to New York. Actually, the speaker's basic intention is to go to San Francisco, but he thinks that one should take the plane to New York first. The answer of the informant depends on what he knows about the belief and basic intention of the speaker and his knowledge about the planes to San Francisco and New York. The informant may just answer the question, without paying attention to what the questioner actually wants. The informant is only more *cooperative* when he helps the questioner on the way to San Francisco, for instance, when the informant knows that there is an easier way to get there.¹

Cooperation can be seen as a way of acting such that an agent intentionally helps to fulfill the goals of his partner. In Grice (1975), general principles underlying the efficient cooperative use of language of rational agents are identified. The so-called *cooperative principle* is expressed as follows:

"Make your contribution such as required, at the stage at which

¹In designing natural language dialogue systems the minimal cooperation required is that the system answers a question literally or executes a command, but, as may be clear from the utterance "Delete all information from your data base", the system cannot be cooperative in all cases.

it occurs, by the accepted purpose or direction of the talk exchange in which you are engaged" (pp. 45)

Next, four categories of more specific maxims and submaxims are distinguished that yield results in accordance with the cooperative principle:

1. The maxim of *quality*
Try to make your contribution one that is true, specifically:
 - (i) do not say what you believe to be false
 - (ii) do not say that for which you lack adequate evidence
2. The maxim of *quantity*
 - (i) Make your contribution as informative as is required for the current purpose of the exchange
 - (ii) Do not make your contribution more informative than is required
3. The maxim of *relevance*
Make your contribution relevant
4. The maxim of *manner*
Be perspicuous, specifically:
 - (i) avoid obscurity in the expression
 - (ii) avoid ambiguity
 - (iii) be brief (avoid unnecessary prolixity)
 - (iv) be orderly

Grice suggests that the maxims are not arbitrary conventions but rather describe rational means for conducting cooperative exchanges and therefore have their analogues in rational cooperative non-linguistic behaviour.

In chapter 6 of this thesis the maxims of quantity and quality are expressed in terms of intentions and beliefs of the speaker. The importance of the maxims in our case is that from the knowledge about the way agents *use* language, listeners can make inferences about the mental state of the speaker. For instance, if a speaker makes a statement and he acts cooperatively, the hearer knows that the speaker believes the content of the statement. Or, if a speaker asks a question, a hearer can infer by means of the quantity and/or relevance maxim that the speaker wants to know certain information.

The first quantity maxim also enables a hearer to supply more information than is actually asked for, since the current goal is taken into

account. This may happen, for instance, when the hearer knows the basic intention of the speaker, although the speaker did not express this intention. For instance, if a speaker asks "Can you pass the salt?", a hearer will interpret the utterance primarily as a request to pass the salt and not as a question concerning the hearer's physical abilities (although both readings may be available). So, from the fact that an actor acts purposefully and behaves cooperatively, inferences can be generated that go beyond the semantic content of the utterances; the inferences are called *implicatures*.

Sufficient restriction of the situation enables the hearer to infer relevant parts of the mental state from the speaker's actions. Here, we should be careful, though, because there is a snake in the grass. Specifically, how should the speaker's action be described? Previously, we used the examples 'statement' and 'question', but, since speakers hardly ever explicitly mention these functions, the hearer has to find the information from other features in the utterance. So, before the action can be determined, we have to describe the observable features conventionally tied to a certain action. In what follows, we will concentrate on the recognition of speech acts, more specifically of questions, and keep in mind that all features can be overruled by contextual aspects. First, we will briefly introduce some general aspects and terminology of speech act theory.

2.4 Speech act theory

In speech act theory (Austin (1962); Searle (1969)), it is assumed that utterances not only can be assigned a truth value, but that utterances also change the world by doing something. For instance, declaratives like:

"I *warn* you that this dog will bite"

"I *promise* you to come"

"I *ask* you to leave"

"I hereby *pronounce* you man and wife"

do not describe a certain state of affairs, but are used to perform certain actions. Such sentences and their main verbs are called *performatives* and *performative verbs*, respectively. Although the sentences cannot be true

or false, they can be infelicitous,² i.e. certain conditions can be absent that must be met before the performative can be successfully carried out. These conditions are called the *felicity conditions*, i.e. the necessary conditions to perform a certain act. In many cases, performatives can only be performed felicitously if particular institutional arrangements are present. Not only must the speaker have certain beliefs and intentions, the circumstances must also be appropriate. Simply saying "I hereby christen the ship *New Magic Breeze*" cannot count as naming a ship without the presence of a ship, a bottle of champagne, witnesses, an appropriate person chosen to name it, etc.

Austin claimed that, in uttering a sentence, three kinds of acts are simultaneously performed: the *locutionary*, the *illocutionary* and the *perlocutionary act*. The locutionary act is the production of a sentence with a particular sense and reference.³ The illocutionary act is the performance of a certain act by virtue of the conventional force associated with it, e.g., 'stating', 'promising', 'warning', etc. The perlocutionary act is what is achieved by performing the act, i.e. the bringing about of certain effects on the listener, such as 'convincing', 'scaring', etc.

The focus of Austin's theory lies in the second act, which is also called the *speech act*. With every illocutionary act, an *illocutionary force* can be associated that explicitly names the type of act performed. For instance, if, in the appropriate circumstances, a speaker utters the sentence "The dog is in the house", the illocutionary force may be: 'stating' or 'warning'; the perlocutionary effects may be: 'convincing' or 'scaring'. The illocutionary acts are supposed to be conventional and the perlocutionary acts are specific to the circumstances of the utterance. However, there are certain problems associated with the word 'conventional', since the illocutionary forces above are not independent of the circumstances, and the only cases where we can speak of a conventional force are the institutionalized performatives like 'christening', 'declaring', etc. Another problem is that declaratives cannot simply be tied to statements, interrogatives to questions and imperatives to orders or requests and it

²It can be argued, however, that these sentences are true after they are uttered and false before. But even when this is so, it is obvious that the world has changed.

³Actually, Austin distinguishes the *phonetic act* (i.e. the act of making sound), the *phatic act* (i.e. uttering words with a certain grammar and intonation) and the *rhetic act* (uttering a sentence with certain sense and reference).

is certainly not clear how other utterance features can be linked to the actual illocutionary act performed. We will return to this problem later on.

A second important contribution to the theory of speech acts comes from Searle (1969). Searle's account of speech act theory can be considered as an elaboration of Austin's work, especially on the felicity conditions (FCs) of the illocutionary act. Although Searle accepts the same terminology, he does not distinguish in the same way between the illocutionary and locutionary act. Searle takes the term *propositional act* as referring to Austin's act of referring and predicating. Now, the illocutionary act is rewritten as a function, the illocutionary force, and its argument, the propositional content. For instance, the utterance "Is John sleeping?" may have the force of 'questioning' and the content 'SLEEP(John)'; the illocutionary act is represented as 'Question(SLEEP(John))'.

Searle suggests a classification of FCs into four types: *propositional content*, *preparatory*, *sincerity* and *essential conditions*. Let us clarify the classification with an example: the illocutionary act of 'questioning' (Searle (1969): pp. 66).

S = speaker, H = hearer

Propositional content: can be any proposition or propositional function

Preparatory:

1. S does not know the answer
2. It is not obvious to both S and H that H will provide the information at that time without being asked

Sincerity:

S wants the information

Essential:

Counts as an attempt to elicit the information from H

Searle argues that there are two kinds of questions, a. real questions and b. exam questions; in the first the speaker wants to find out the answer and in the latter the speaker wants to find out whether the listener knows the answer. Note that in the latter case, the first preparatory condition would not be fulfilled, hence, either the conditions are too restrictive or the exam question is no real question in Searle's view.

In this thesis, a question is primarily taken as a signal from a speaker to a hearer that the speaker wants certain information. To some extent, this definition agrees with a combination of Searle's sincerity and essential conditions on questioning. In Searle's essential condition it is explicitly mentioned that the question should be seen as an attempt to elicit information from H. In our view, the information may come from anywhere, but will most likely come from H, because H acts cooperatively, and the speaker is aware of H's cooperative behaviour. Note that in the case of the exam question, the speaker explicitly wants the information to come from the hearer. This situation, though, falls outside the scope of the information dialogue. In chapter 6, we will see that the first preparatory condition can be inferred from rules of rational behaviour combined with the sincerity condition. Levinson (1983) also suggests that the FCs will probably follow from general considerations of cooperation and rationality.

In line with Cohen & Levesque (1989b), we will take the view that illocutionary forces need not be explicitly recognized by a hearer. This may sound contradictory, as this thesis is about the identification of questions. However, illocutionary forces will be considered as labels of parts of the speaker's mental state. The hearer only has to identify the speaker's beliefs and intentions from the observable properties of the utterance, such as 'declarative', 'rising intonation', etc., and may omit the explicit determination of the illocutionary force in terms of performative verbs. The speaker's mental state will be expressed in terms of sets of propositions qualified by the attitudes 'Belief' (B) and 'Intention' (I), built into a logical framework with the appropriate axioms. An important advantage of this approach is that the Gricean maxims can be brought within the logical framework and that the felicity conditions are not linked to a particular illocutionary force but are subject to general rules of rationality and cooperative behaviour.

Illocutionary acts will be considered in a Searlean sense, i.e. the application of the illocutionary force as a function to its argument, the propositional content. For that reason, the term 'illocutionary force' will, in most cases, be replaced by 'communicative function' (CF), and also 'illocutionary act' will be replaced by 'communicative act' to refer to the conception of an action intentionally performed to change certain

aspects of the world (see also Bunt (1989a)).

2.4.1 The identification of speech acts

Turning now to the identification of an illocutionary act, we should consider the conventions to express a certain act. It should be noted, though, that we are not concerned with what is *linguistically* correct, since the data discussed in the following chapters comes from human behaviour in dialogues, not from what linguists consider as correct or relevant conventional usage.

The most overt linguistic indicator of the illocutionary force is the (sincere) use of an explicit performative,⁴ like:

- "I hereby *ask* you what time it is"
- "I hereby *confirm* my reservations"
- "I hereby *check* whether John has gone"

However, explicit performatives are seldom used. Austin discusses other features, apart from situational aspects, that may also indicate a particular illocutionary force:

Mood: By *mood* Austin refers to what we will call *sentence type*, e.g., 'declarative', 'interrogative' and 'imperative'. Some examples are:⁵

sentence type	example	illocutionary force
Declarative	"John drinks beer"	statement
Interrogative	"Does John drink beer"	question
Imperative	"Drink beer, John"	order

Tone of voice, cadence, emphasis: Henceforth, these features will be called 'prosodics'. In written language they may be replaced by punctuation, italics, etc. One has to be careful, though, especially in transcriptions of spoken dialogues, where question-marks often indicate the utterance's *function*, and not its prosodic characteristics. Some examples are:

⁴The explicit performative is not decisive in all cases. For instance, in the appropriate circumstances, the utterance "I promise you that I will return" can be meant as a 'warning', and not as a sincere act of 'promising'.

⁵For a discussion on the relation between sentence type and illocutionary force, see e.g., Geukens (1986).

prosodics	example	ill. force
final fall	"There is a dog in the house."	statement
final rise	"There is a dog in the house?"	question
accentuation	"There is a DOG in the house!"	warning

Connecting particles: Austin discusses some particles that may replace the use of an explicit performative. For instance, the particle 'still' indicates 'I will insist that'; 'therefore' and 'so' indicate 'I conclude that', etc.

Accompaniments of the utterance: Utterances may be accompanied by non-verbal phenomena, like gestures (winks, pointing, frowning, etc.) or ceremonial non-verbal activities.

2.4.2 The identification of questions

In Clark & Clark (1977) the following syntactic strategy is described to identify the function of a clause in a sentence from its first constituent:

"Use the first word (or major constituent) of a clause to identify the function of that clause in the current sentence." (pp. 68)

So, if the main clause begins with a WH-word, it is a WH-question. Whenever a clause begins with an auxiliary verb (in English) it is a Yes/No-question. An exception of the WH-word is formed by 'exclamatives', like "What a beautiful launderette he has!"; in such cases, however, the clause has no subject-verb inversion. However, the following examples can hardly be considered as sincere acts of questioning:

(1) "What did you say? Peter crashed my car. I can't believe it."

It is not difficult to find other counter-examples where the main clause starts with an auxiliary:

(2) "Don't I know what a carburettor is? I'll teach you."

(3) "May I remind you that we have to leave early?"

(4) "Didn't you forget to close the door?"

In (1) and (2) the speaker does not fulfill any of the felicity conditions suggested by Searle and the question can be interpreted as rhetorical. In (3) the speaker asks literally whether he may remind the hearer that they have to leave early. However, the speaker does not await the answer, hence the sincerity and the essential conditions are not fulfilled (see also Levinson (1983)). And the utterance in (4) may simply count as an indirect request by the speaker to close the door.

We may hope that in spoken dialogues information about the question function of the utterance comes from prosodics. However, this hope is often vain. Geluykens (1988) has shown that (at least in British English) in many cases intonation is not used to distinguish sincere questions from interrogatives without question status. Even in cases where a declarative sentence type was used (DQs), a falling intonation pattern was by far the most frequent pattern (68%). Our findings confirm this for Dutch. Hence, it is to be expected that a simple form-force correlation does not exist and that the utterances' function is heavily influenced by contextual features.

Chapter 3

The auditory recognition of declarative questions

R.J. Beun

[A slightly revised version of this chapter was accepted in: Taylor, M.M., F. Néel & D.G. Bouwhuis (Eds.) (1989) The structure of multimodal dialogue. Amsterdam: North Holland]

abstract

In this paper two experiments are presented on the recognition of questions with a declarative sentence type (DQs) in Dutch. DQs were isolated from previously recorded telephone dialogues and mixed with answers. In the first experiment subjects had to determine from audio tape the function (answer or question) of the isolated utterances. The second experiment was carried out to determine the indicators which played a decisive role in the responses of the subjects. To this end, possible question indicators were removed from the utterances and subjects were asked to perform the same task as in the previous experiment. It followed that important question indicators were given by the pragmatic particles such as *en* (*and*) and *dus* (*so*). A substantial part of the questions in isolation could not be labelled with the correct function; it is concluded that identification in the original dialogues often had to come from contextual knowledge.

3.1 Introduction

In general it is assumed that questions in natural language are represented by sentences with an interrogative sentence type (example 1a).¹ In natural dialogues, however, one finds many utterances with a declarative sentence type which clearly fulfill the function of a question.² Sometimes these utterances have clear cues to indicate this function, e.g. the use of special words (example 1b) or, as indicated by the question mark in (1c), a rising intonation at the end of the utterance in spoken language:

(1a) "Are you invited to the party?" (interrogative)

(1b) "So, you are invited to the party." (declarative)

(1c) "You are invited to the party?" (declarative)

Although we will not consider the exact contribution of the indicators to the function, one can roughly say that the word *so* in (1b) and the combination of declarative sentence type and rising intonation in (1c) not only seem to express the question as in (1a) but also a speaker's supposition about the answer.

In many cases clear indicators are absent and the determination of the function seems to come from contextual cues only. The recognition of questions (and of course answers) is of crucial importance for a proper continuation of the dialogue; so we would like to find special characteristics in the utterance which could indicate its question function even in the absence of contextual cues.

We will use the theoretical framework of Bunt's *communicative acts* (Bunt (1989a)). In doing so we have restricted ourselves to so-called *information dialogues* in which the participants have no other purpose than the exchange of factual information. A communicative act is determined by the combination of its *semantic content* and its *communicative function* (CF). This function stipulates the role of the semantic content in the dialogue and relates it to the speaker's knowledge and goals. The CF of the utterances in (1b) and (1c) for example is a CHECK with semantic

¹Following Gazdar (1981) we will regard sentence type as a purely syntactic characteristic of sentences.

²Here an utterance should be taken in the sense of a sentence paired with a context (see e.g. Levinson (1983): pp. 18-19, or Gazdar (1981)).

content INVITED(H,party) where H is the hearer of the utterance. In terms of knowledge and goals the preconditions of these utterances are respectively:

- (2a) S wants to know whether INVITED(H,party)
- (2b) S suspects (or knows) that H knows whether INVITED(H,party)
- (2c) S suspects that INVITED(H,party)

In this paper we present an experimental study of questions with a declarative sentence type in natural dialogues. Subsequently, two experiments were carried out to find out whether subjects are able to recognize the CF of utterances detached from the context. The utterances were obtained in previous dialogue experiments which will not be considered here (see Beun (1985)).³ As discourse situation we used the information exchange by telephone⁴ concerning arrival and departure times of planes and trains at Schiphol (Amsterdam airport). The dialogues will be called 'Schiphol dialogues'.

3.2 The corpus of utterances

All utterances investigated in this paper are declarative questions (DQs), i.e. questions, but with a declarative sentence type. Both complete and elliptical utterances are considered. Since in the case of elliptical utterances it is difficult and sometimes impossible to determine the sentence type, only those instances with clear interrogative or imperative features were excluded from the corpus.

To determine if an utterance is a question, even in the absence of syntactic indications, the following definition is used:

DEF An utterance U is a declarative question if:⁵

³Dutch speaking subjects had to determine by telephone the departure and arrival times of airplanes and trains from an informant at Schiphol airport. The informant was simulated by a well-trained person. Each subject read eight sets of instructions to tell them what kind of information had to be obtained.

⁴Here we avoid non-verbal aspects of communication which are difficult to measure such as eye-contact, body-movement, etc.; so everything can be collected from the original speech signal.

⁵The interpretation of sentences defined by **DEF** as a question also agrees with the maxim

- a. The sentence type of the sentence expressed by U is declarative (or if the sentence is elliptical the sentence type is at least non-interrogative and non-imperative).
- b. The utterance U, uttered by S, is about a topic on which S believes that H is the expert.
- c. S believes that S and H mutually believe that H is the expert on the topic.⁶

Note that we have excluded sentences as:

(3) "I want to know what time it is"

(4) "Can you tell me what time it is"

The reason is that (3) is not a direct question as far as the literal interpretation is involved: in (3) the literal topic is the goal of the speaker, who is the expert on his own goals. (4) is excluded because of its interrogative sentence type.

In many cases where a matrix sentence contains a performative verb in the second person, past tense, the definition is satisfied,⁷ e.g.:

(5) "You said that the plane will leave at ten"

(6) "You stated that the Germans will win"

For, in the restricted domain we use here, the addressee knows best what he has said, stated, etc. The same can be said about epistemic or doxastic verbs in the second person, present or past tense, e.g.:

(7) "You mean that I have to leave at ten"

of quantity, for if the addressee knows more about the subject than the speaker (and this is mutually believed) the utterance would be superfluous in the case of a statement.

⁶'S and H mutually believe that p = (q) S and H believe that p and that q'. See also Clark and Marshall (1981).

⁷In special circumstances one can use these forms to focus certain aspects of an addressee's knowledge or actions to introduce for instance counterexamples, e.g.:

"You stated that indirect speech acts can be explained by means of felicity conditions, but how then do you explain the utterance "It's cold inside" as a request to close the window."

We did not encounter any of these examples in our restricted domain.

(8) "You think that I'm joking"

Again, the addressee knows best what he means, thinks, etc. In the next sentence, however, it is not clear what the CF is without contextual knowledge:

(9) "The train leaves at 12.00"

Uttered by an informant in the dialogue experiments the CF can be an answer, uttered by one of the subjects the CF can be a DQ,⁸ even without a rising intonation at the end. In fact only 48% (37 out of 77) of the DQs which appeared in the dialogue experiments had a rising intonation.

DEF is largely based on contextual characteristics such as *topic* and *mutual belief*. We expected however that certain characteristics of the utterances (prosodic or textual) could indicate the CF without the use of context. From a linguistic angle one can think of the use of special words such as *so*, *thus*, etc.⁹ Prosodic cues could for instance be given by intonation, accentuation or declination. To find out whether these indicators contribute to the interpretation of the CF we carried out the experiments described in the following sections.

3.3 The first experiment

From the Schiphol dialogues we isolated 77 declarative questions (DQs).¹⁰ Forty seven utterances were excluded from the experiment because the 'DQ indicators' were so clear that it was feared that the subjects would only pay attention to these clear cases to distinguish the CF.¹¹ These clear indicators were: 1. rising intonation at the end of the utterance (37 utterances), 2. the use of Dutch particles such as: *hè*, *toch*, *zeker* (13 utterances) and 3. the use of special verbs as described in the previous section (6 utterances). Some utterances possessed two or more of these indicators. The remaining 30 DQs were mixed with 24 answers, which were also taken from the Schiphol dialogues.

⁸Strictly speaking a DQ is not a communicative function because it contains syntactic information; this characterization is only maintained for the sake of simplicity.

⁹In Dutch these particles are widely used in natural dialogues, e.g. *wel*, *toch*, *dus*, *en*, *ook*, etc.

¹⁰We had no problems with interruptions because the voices of the informant and the subject were recorded on different tracks. (TEAC A3440 4-channel simul-sync)

¹¹At this moment this is just a supposition and still has to be tested.

The task of the subjects was divided into two parts; in one part they had to indicate for each utterance whether it was a question or not (question task), in the other part they had to say whether the utterance was an answer or not (answer task).¹² The subjects did not know (before and after the experiment) that in both cases the same utterances were used.

This first experiment was only meant to give a rough indication about the ability of subjects to recognize the CF in general, so only six Dutch subjects (of both sexes, all over 18) took part in the first experiment. They had to write down their responses on paper and they could think about their responses as long as they wanted.

Before we discuss the results we will introduce some abbreviations. To distinguish the original CF (known from the context) from the responses given by the subjects we will always write the first one in capital letters. The responses of the subjects will be divided into 4 parts:

(yes)question: the utterance is interpreted as a question in the question task.

(no)question: the utterance is interpreted as not being a question in the question task.

(yes)answer: the utterance is interpreted as an answer in the answer task.

(no)answer: the utterance is interpreted as not being an answer in the answer task.

If the subjects agreed in more than 90% of the cases on a question as CF of an utterance (percentage of both *(yes)*questions and *(no)*answers > 90%), the utterances were called '**Q-utterances**'. Conversely if the subjects agreed on an answer in more than 90%, the utterances were called '**A-utterances**'. (Note that this has nothing to do with the original CF.) Responses are called 'inconsistent' if a subject interpreted the same utterance as *(yes)*answer and *(yes)*question or as *(no)*answer and *(no)*question.

¹² Actually the subjects also had to answer whether the utterance was an 'inform' (Dutch: 'mededelings'). We did not investigate these results, so they are omitted.

3.4 Results

70% (199 out of 285)¹³ of the ANSWERs and 69% (242 out of 351) of the DQs were correctly identified. (Note that 50% would be purely random.) By 'correctly identified' we mean that, if the utterance was a DQ, the subjects responded: (*yes*)question and (*no*)answer, and vice versa if the utterance was an ANSWER. 11% of the ANSWERs and 12% of the DQs were identified inconsistently, so there were no striking differences between the ANSWERs and DQs.

These results do not look very spectacular. When we consider every utterance separately, however, some interesting results appear. Table 3.1 shows the number of utterances as a function of the CF and the percentage of correct responses per utterance. The maximum number of correct responses per utterance is 12, i.e. the total number of responses of the subjects per utterance in both answer and question task.

Table 3.1: Number of utterances as a function of the original CF and the percentage correct responses per utterance.

	correct responses per utterance		
	> 90%	> 10% and < 90%	< 10%
DQ	11	17	2
ANSWER	8	15	1

From Table 3.1 it can be seen that 19 (17 + 2) DQs were not correctly identified, which agrees almost 25% of the total number of DQs in the dialogues. Also, in 19 (11 + 8) cases the subjects could almost perfectly identify the CF (both DQ and ANSWER), in 3 (2 + 1) cases the CF is inverted (ANSWER \rightarrow Q-utterance, DQ \rightarrow A-utterance) and in 32 (17 + 15) cases the subjects could hardly identify the CF. Note that the first and the last column, i.e. the percentage of correct responses > 90% and < 10%, respectively, shows the number of Q- and A-utterances.

But how do subjects identify the Q- and A-utterances? In other words, what special characteristics do these utterances have to reveal the CF? To discover this, all Q- and A-utterances were analysed on intonation

¹³In some cases subjects did not make any decision at all, so the total numbers of ANSWERs and DQs differ from $12 \times 24 = 288$ and $12 \times 30 = 360$ respectively.

patterns but no special differences appeared between these utterances.¹⁴ However, there seemed to be an important difference in the use of special words. Almost all Q-utterances contained particles like *en* (*and*)¹⁵ at the beginning of the utterance, *dus* (*so*), *ook* (*also*), etc. These words were missing in the A-utterances. In Table 3.2 the occurrence of special words is shown for the Q- and A-utterances. *Uncertainty* was expressed by words as *ongeveer*, *pak em beet*, etc. (*about*, *roughly*, etc.) or the pause-particle *uh*.

Table 3.2: Occurrence of indicators as a function of Q-and A-utterances

	indicator			
	<i>dus</i>	<i>en</i>	<i>ook</i>	uncertainty
Q-utterance	5	6	4	4
A-utterance	0	0	0	2

Note that in Table 3.2 the use of Q- and A-utterances, instead of DQ and ANSWER, implies that the subjects agreed in more than 90% on the interpretation of the CF, and does not imply that the subject's responses were correct.

These indicators can also be used in answers; so we had the impression that prosodic aspects also contributed to the interpretation of the CF. In the second experiment, described in the next section, these linguistic indicators were removed from the utterances.

3.5 The second experiment

In the second experiment we used the following utterances (total 33) from the previous one:

1. all Q-utterances (11 utterances)

¹⁴We have one DQ, however, where all the subjects responded correctly, with an unusual, very horizontal declination line. This could be an indication, but because of the lack of other examples any conclusion of this sort seems to be premature.

¹⁵The English translations are only meant as a general indication about the meaning.

2. all A-utterances (8 utterances)
3. utterances with the following characteristics (26 utterances):
 - a. The appearance of the word *en* (*and*) and *oh* at the beginning of the utterance.
 - b. The appearance of the pragmatic particles *dus* (*so*), *ook* (*also*) and *niet* (*not*).
 - c. The appearance of the pause particle *uh*.
 - d. Mistakes followed by self-repair.
 - e. Words which indicate uncertainty.

In most cases, the Q- and A-utterances possessed one or more of the characteristics from (3). Next, these characteristics were removed from the utterances¹⁶ and the 33 original utterances were mixed with the edited ones. Almost the same conditions were applied as in the first experiment; only the number of utterances (total number was 72 of which 39 were edited) differed. Where the utterances had two or more of these characteristics (11 utterances) they were removed in arbitrary order to avoid an exponential growth of the number of these particular utterances. For example, an utterance with three characteristics would give 7 ($= 2^3 - 1$) edited versions; we did not include all combinations but only an arbitrary selection, e.g.:

- (10) "And uh, these are all coming/ going to Munich" (original)
(10a) "And these are all coming/ going to Munich" (edited: 3c)
(10b) "These are all coming/going to Munich" (edited: 3a)
(10c) "These are all going to Munich" (edited: 3d)

In the second experiment 20 subjects took part.

¹⁶First the utterances were entered in the VAX computer and next the special words were removed with the aid of the IPO speech software. This could be done with an accuracy of 25 milliseconds. Some of the utterances (but only very few) sounded a little unnatural; none of the subjects, however, noticed this.

3.6 Results

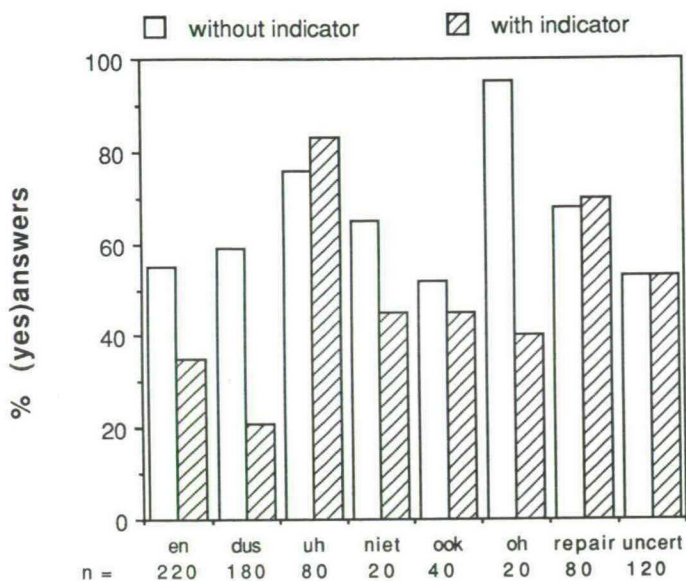


Figure 3.1: The percentage of (*yes*)answers as a function of the presence (shaded rectangle) and the absence (white rectangle) of special indicators.

Figure 3.1 shows the difference in (*yes*)answers to utterances with (shaded rectangle) and without (white rectangle) special indicators. Note the considerable variation in the number of utterances per indicator (= number of responses (*n*) divided by 20). Figure 3.2 shows the same for (*yes*)questions.

In Figure 3.1 we can see for instance that 35% of the utterances with indicator *en* (*and*) at the beginning were interpreted as an answer. The same utterances without *en* are interpreted as an answer in 55% of the cases. If we turn to Figure 3.2 we can see that in 64% of the cases with *en* the utterances are interpreted as a question and 51% when the *en* is removed.

The removal of the indicators *en*, *dus* and *oh* had a significant effect in both answer and question task (in all cases: $\chi^2_{df=1} > 4.00$, $p < 0.05$); in

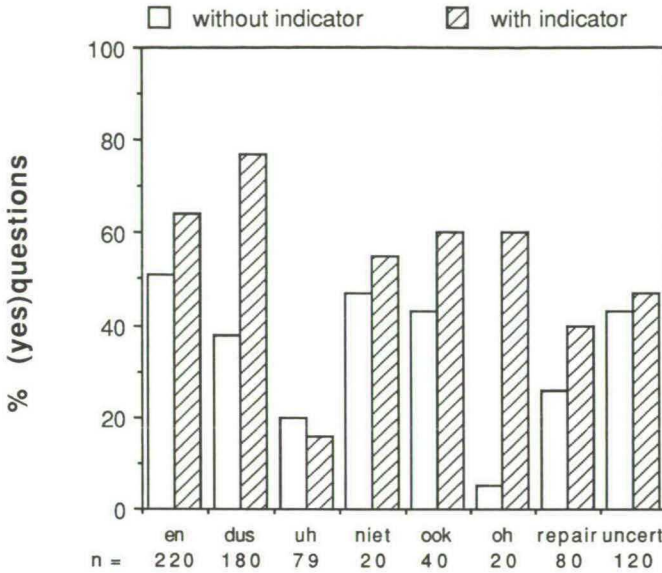


Figure 3.2: The percentage of (*yes*) questions as a function of the presence (shaded rectangle) and the absence (white rectangle) of special indicators.

the other cases no significant effects occurred (in all cases: $\chi^2_{df=1} < 1.23$, $p > 0.27$).

Note that Figures 3.1 & 3.2 do not have to be complements, because responses to the same utterance by the same subject can be (*no*)question and (*no*)answer (12%, or 166 out of 1440) or (*yes*)question and (*yes*)answer (10%, or 149 out of 1440).

3.7 Discussion

From Table 3.1 it can be seen that the subjects were able to recognize the CF in 35% (19 out of 54) of the cases; in 4% (3 out of 54) the function was inverted. Table 3.2 shows that important indicators to recognize the question function can be the word *en* at the beginning of the utterance, and the words *ook* and *dus*. These words were missing in the utterances

which were recognized as answers. When these words were removed from the Q-utterances they never shifted to A-utterances completely, so other characteristics must be involved in the interpretation.

We will now consider some of the indicators separately.

***En* at the beginning of the utterance:** In Figure 3.1. we can see that the removal of the word *en* is of consequence for the interpretation of the CF. When the *en* is not removed, the subjects prefer the 'question' interpretation (35% (*yes*)answer, 64% (*yes*)question). When the *en* is cut out, the responses shift to an 'answer' interpretation (55% (*yes*)answer, 51% (*yes*)question). Note that the (*yes*)answers and (*yes*)questions are independent because they were given in different tasks. Here it is to be expected that the influence of prosodic aspects will be very small because the *en* was never accentuated and forms only a small part of the speech signal of the complete utterance.

***Dus*:** In this case the shift from question responses (21% (*yes*)answer, 77% (*yes*)question), when *dus* is included, to answer responses (59% (*yes*)answer, 38% (*yes*)question), when *dus* is removed, is rather dramatic. In this case too, the word was never accentuated; so it can be expected that the prosodic effects will be very small and that the shift is mainly caused by its textual meaning.

***Oh*:** Again we see a dramatic shift from question responses (40% (*yes*)answer, 60% (*yes*)question), when *oh* is included, to answer responses (95% (*yes*)answer, 5% (*yes*)question) when *oh* is removed. Note however that in this case we had only one utterance (number of responses= 20) and the CF of the original utterance was an ANSWER. The shift can be explained by the fact that in Dutch the *oh* at the beginning is often used to express surprise about the content of a previous statement and in many cases is followed by an utterance which asks for an explanation. In this case the *oh* was uttered because the subject in the dialogue experiment had not expected the previous question from the informant, because he did not pay attention to her. So, the particle had nothing to do with the content of the question.

Ook and *niet*: Although the removal of these particles had no significant effect, in both cases the interpretation shifts from question to answer.

When *ook* is included: 45% (*yes*)answer and 60% (*yes*)question.

When *ook* is removed: 52% (*yes*)answer and 43% (*yes*)question.

When *niet* is included: 45% (*yes*)answer and 55% (*yes*)question.

When *niet* is removed: 65% (*yes*)answer and 47% (*yes*)question.

Semantically these words seem to contribute little to the CF. An explanation for the shift can possibly be found in the prosodic properties of the words. Both words were accentuated and the removal of the accents could have influenced the responses of the subjects.

The insertion of repair sequences, the expression of uncertainty and the use of the pause particle *uh* did not change the responses significantly, so these indicators do not seem to contribute to the interpretation of the CF.

3.8 Conclusion

To determine the question function of a declarative utterance, one can concentrate on linguistic cues in the utterance and on contextual cues from the discourse situation. In this paper we have concentrated on the first category, both prosodic and textual cues.

It was found that only 48% of the DQs in dialogues possessed a rising intonation and that in other cases question indicators may come from Dutch pragmatic particles such as *en*, *dus* and *oh*. 'Easy cases' to determine the question function, such as rising intonation, the use of the particles *hè*, *toch* and *zeker* and the use of verbs like *mean* and *say* were excluded from our experiments and their influence still has to be tested. In almost 25% of the cases the DQ could not be identified from either prosodic or textual cues; so, question cues could only be provided by the context.

An important shortcoming in the analysis is that the removal of particular words has the consequence of cutting out certain prosodic aspects as well. We expect to solve this problem in a following experiment in which the utterances will be presented on a screen.

Chapter 4

The visual recognition of declarative questions

R.J. Beun

[A slightly revised version of this chapter has been accepted for publication in: Journal of Pragmatics]

abstract

In this paper it is discussed how questions in Dutch with a declarative sentence type can be recognized in isolation and in natural dialogue. Declarative questions were taken from telephone dialogues where subjects tried to get information from an information clerk at Amsterdam airport. In previous experiments these questions were isolated from the original context and presented on tape to subjects together with a number of answers. A disadvantage of this method is that it is difficult to distinguish the influence of prosodic indicators from that of textual ones. Here, an experiment is described where utterances were presented on a screen to eliminate prosodic characteristics and to concentrate on textual indicators only. In the interpretation by the subjects of the declarative as a question the presence of certain pragmatic particles will be shown to play a decisive role.

4.1 Introduction

Two important aims in speech act theory are (1) to describe how illocutionary acts can change the mental state of agents over time and (2) to relate the syntactic and semantic features of utterances to the illocutionary act that is performed.

In many Artificial Intelligence approaches the burden is placed on the development of theories which describe the effects of utterances on the mental states of agents participating in a dialogue in terms of beliefs, knowledge, and intentions (see e.g., Cohen & Levesque (1989b), Perrault (1989), Bunt (1989a)). The precise role of certain syntactic and semantic features in contributing to the speech act is usually limited to the sentence types *declarative*, *imperative*, and *interrogative* or sometimes totally neglected. If we assume that the production of utterances with particular features reveals particular aspects of the mental state of the speaker, then we have to know precisely *what* features and *what* aspects. We will assume that parts of a mental state can be communicated by the performance of a certain illocutionary act and presume that the act is obtained from the application of the illocutionary force (IF) to its semantic content¹ (Searle (1969), Gazdar (1981), Bunt (1989a)). In this paper, the determination of the act will be restricted to the identification of the IF. We will try to answer the question as to which indicators are potential candidates in the identification and how these indicators correlate with the IF of the utterance in a specific case.

Austin has already argued (Austin (1962): pp. 76) that the circumstances of the utterance are "an exceedingly important aid" in the recognition of the IF. Indicators in the utterance itself can be divided into two classes: prosodic and textual indicators. Possible indicators in the prosodic class can be *accentuation*, *declination* and *special intonation patterns* (see e.g., Hadding & Studdert-Kennedy (1974), Thorsen (1980), Geluykens (1987)). Textual cues are, for instance, *sentence type* and *special pragmatic particles* (see e.g., van Dijk (1977), Berenst (1978), Abraham (1984)).

We will concentrate here on the information available in the utterance itself, especially its textual features. The sentence type of the utterances will be restricted to a *declarative* one and only those indicators will be considered that contribute to a *question* force of the declarative in natural dialogue. We will call these utterances *declarative questions* (DQs).

In some cases special characteristics are attached by the speaker to a DQ to indicate its question force; in other cases the question force

¹ We use the term *semantic content* or *content* instead of the often used *propositional content* (see Bunt (1989a): pp. 59).

is indicated by contextual cues only. The following simulated dialogues illustrate this point:

1. (a) **A:** ... Can you tell me what time the KL402 leaves from Schiphol airport and what time my sister has to leave from Eindhoven by train to catch her plane in time?
- (b) **B:** The plane leaves at 12.30, she has to check in one hour before and the trip from Eindhoven to Schiphol takes about one and a half hours.
- (c) **A:** *So, she has to leave around 9.45 from Eindhoven?*
- (d) **B:** Yes.
- (e) **A:** Thank you very much.

It is not difficult to think of an example where utterance 1(c) is used without the question force:

2. (a) **A:** ... Can you tell me what time the KL402 leaves from Schiphol airport and what time my sister has to leave from Eindhoven by train to catch her plane in time?
- (b) **B:** The plane leaves at 12.30, she has to check in one hour before and the trip from Eindhoven to Schiphol takes about one and a half hours. *So, she has to leave around 9.45 from Eindhoven.*
- (c) **A:** Thank you very much.

Clearly, the italicized utterances in 1(c) and 2(b) have different forces, although their surface structure and content are identical. Note that the punctuation marks in both utterances do not have to correspond to prosodic cues. Quirk, Greenbaum, Leech & Svartvik (1972) state that the question in 1(c) is similar in force to tag questions and that the final rising tone suggests that the speaker takes the answer *yes* as a foregone conclusion. In Dutch, however, (and probably also in English) the utterance often lacks the final rise in natural spoken conversation (Beun (1989)).

To determine the force indicators of a DQ we have opted for an empirical method, where people were asked to decide whether a declarative was a question or an answer.² To exclude contextual dependency of the

²The actual experiment was slightly more complicated; we will return to this in section 4.4.

responses of the subjects as much as possible, the utterances were taken from a fixed, relatively simple domain of discourse, namely telephone dialogues about the arrival and departure times of planes and trains from Amsterdam airport.

Before we discuss the experiment and its results in sections 4 and 5 respectively, some attention should be devoted to how declaratives can be understood as questions in natural dialogue. In section 4.2 we will sketch how DQs can be picked out from the dialogues. In section 4.3 the most striking question markers in the recorded dialogues will be considered and the results of previous auditory experiments will be summarized.

4.2 The notion of declarative question

The notion of *literal force* subscribes to the idea that illocutionary force is built into sentence form (see e.g., Levinson (1983)). This means that, unless the sentence possesses explicit performative properties, a declarative is meant for stating something, an interrogative for questioning and an imperative for ordering or requesting. So, the notion of literal force suggests a strong relation between sentence type and function of the utterance. Any usage of a sentence not in accordance with the previous notion is considered to be *indirect*.

Here, we will avoid the problem whether the declaratives discussed in this paper are direct or indirect and consider declarative as a purely syntactic feature of the sentence (see also Gazdar (1981)). From the set of declarative utterances in the dialogues, it is possible to select a subset that functions as questions by a rule concerning the beliefs of the dialogue participants as to who is the expert on the topic of the utterance.

A precise definition of a declarative sentence is hard to give. Should we, for instance, include prosodic properties in our definition, and can elliptic sentences be determined as being declarative? For the present, we will leave this to the intuition of the reader and concentrate on the way declarative utterances that function as questions were selected.

Let us first introduce some abbreviations. $B_x p$ and $MB_{xy} p$ will be x believes that p and x and y mutually believe that p ($B_x p$ & $B_y p$ & $B_x B_y p$ & $B_y B_x p$ & ...), respectively. To concentrate on the belief of one agent, a one-sided version of mutual belief will also be used: $BMB_{xy} p$ ($B_x p$ &

$B_x B_y p$ & $B_x B_y B_x p$ & ...). The content of the utterance U is p ; H and S are hearer and speaker, respectively.

We call an utterance U a *declarative question* if and only if:

DEF:

- a. The sentence type of U is declarative.
- b. S believes that H is the expert on the topic: $B_S Expert_H(topic(U))$.
- c. S believes that it is mutually believed that H is the expert on the topic: $B_S M B_{SH} Expert_H(topic(U))$.

From the Gricean maxim of quantity (Grice (1975)) it follows that the utterances defined by DEF lead to an implicature, or as Searle suggests, an indirect interpretation (Searle (1975)), for if the addressee already knows the content of the utterance (and this is mutually believed) it would be superfluous.

Note that, if we assume that both 'positive introspection' ($B_x p \rightarrow B_x B_x p$) and 'distribution of conjunction' ($B_x p \& B_x q \leftrightarrow B_x (p \& q)$) hold, it can be inferred that the notion of mutual belief can be expressed in terms of one-sided mutual belief:

1. $B_x p \& B_x M B_{xy} p \leftrightarrow B M B_{xy} p$

In the definition, the concept of (one-sided) mutual belief is crucial. If the speaker does not believe that the hearer is the expert, then the speaker's utterance cannot be meant as a question, therefore $B_S Expert_H(topic(U))$ must be true. On the other hand if the speaker does not believe that $B_H Expert_H(topic(U))$, the speaker would think that the hearer cannot interpret the utterance as superfluous and therefore cannot infer that the utterance is meant as a question. So, if the speaker produces an utterance for which he does not expect an answer, then the utterance can never be meant as a question. Therefore, $B_S B_H Expert_H(topic(U))$ is also true, and so on. This leads us to (2):

2. $B_S Expert_H(topic(U))$ &
 $B_S B_H Expert_H(topic(U))$ &
 $B_S B_H B_S Expert_H(topic(U))$...

which is equivalent to $BM_{BSH}Expert_H(topic(U))$ and by means of (1) is equal to DEF (b) and (c). Note that if $BSExpert_H(topic(U))$ is not the case, the utterance can never be meant as a question; however, the hearer may interpret the utterance as a question if $B_HExpert_H(topic(U))$. We did not investigate these cases.

One might think that the selection of the declarative questions from real-life dialogues still causes great difficulty because of the lack of a precise definition of terms such as *expert*, *topic*³ and *declarative*; in practice, though, we seem to have a very good intuition of the terms and we will try to clarify this by some examples.

We will refer to topic loosely as *what the utterance is about*. For instance, (3) is about the goal of the speaker.⁴

3. "I want to know what time it is"

The utterance is, although declarative, rejected by DEF because we will presume that the speaker is the expert on his own goals. So topic is restricted to the literal interpretation of the utterance. The same argument counts for sentence (4), where a performative is used in the matrix sentence, for the explicit performative indicates that the utterance is about the act of the speaker and the speaker knows best what act he performed by uttering (4).

4. "I state that the capital of Corsica is Corte"

A (perhaps unwanted) consequence of DEF is that sentence (5) is also rejected by DEF because of the explicit performative in the matrix sentence.

5. "I ask you what time it is"

The previous examples bring us to the cases where DEF is satisfied. We simply change the first person to the second, so in many cases where the matrix sentence contains a boulemaic, epistemic or doxastic verb in the second person, present or past tense, the definition is fulfilled, e.g.:

³See for instance Lugtenburg (1985) for a survey of definitions on topic.

⁴Here, punctuation marks are left out to concentrate on lexical cues only; other interpretations can be obtained when, for instance, in spoken form special intonation patterns are used.

6. "You want to go to Venaco"
7. "You know whether Corsica is ruled by Italians"
8. "You thought that I have to leave at ten"

For the addressee knows best what he wants, thinks, etc. The same can be said about performative verbs in the second person, past tense, e.g.:

9. "You asked the exact departure time"
10. "You said that the plane will leave at ten"

Again, the addressee knows best what he asked, said, etc. So, one would expect that if these utterances are presented to subjects, they will identify them as a question. In special circumstances, however, one can use these forms to highlight certain aspects of an addressee's knowledge or actions, e.g.:

11. "You said you would leave at ten. So, why are you still hanging around?"
12. "You asked the exact departure times. Well, here they are."

These utterances are mainly used as an introduction to criticize an act performed by the hearer (11) or to refresh the hearer's memory about his own acts (12). So, the interpretation of the utterance as a question can be rejected by contextual information. We did not encounter any of these examples in our material.

All previous examples have clear indicators in the sentence itself. In (13) it is impossible to determine the illocutionary force of the utterance without contextual knowledge.

13. "The train leaves at 12.00"

Uttered by an information clerk the IF can be an answer, uttered by an information seeker the force can be a question. It was expected, however, that certain textual or, in the case of spoken dialogues, prosodic cues could give an indication about its IF. This would imply that, if the utterances are removed from the context, subjects can still determine its IF. In the next section we will discuss which indicators probably contribute to the question force of a declarative.

4.3 Question indicators in natural dialogue

In this section a survey will be given of the *question indicators* we have come across in the DQs of the recorded dialogues. These dialogues were obtained from an experiment carried out in 1984 and 1985. In the experiment, twenty-four Dutch-speaking subjects had to determine by telephone the departure and arrival times of airplanes and trains from an information clerk at Schiphol airport. The role of the information clerk in the experiment was played by a well-trained person. By using the telephone as the communication channel we avoided non-verbal aspects of the communication, so all force indicators could be collected from the speech material and the set-up of the experiment. To exclude speech interruptions in the recorded signal, the information clerk and the subject were recorded on different tracks of the tape recorder. (See Beun (1985) for a more detailed discussion.)

In total 387 questions were counted in 189 dialogues. Almost 20% of the questions (77 in total) had a declarative sentence type. In Table 4.1 the question indicators are shown together with the number of times they occur in the dialogues. Note that one utterance can have two or more indicators. For example, all utterances with the indicator tag "...hè" ("...right")⁵ at the end also had a rising intonation at the end. In total only 47 utterances (61% of the DQs) possessed one or more of the indicators of Table 4.1; the remaining 30 utterances (39%) did not have any overt indicators. It should be stressed, however, that these results only count for spoken dialogues. In Beun & Bunt (1987) it was shown that the number of DQ's dramatically decreases if people converse without prosodic information: in terminal conversation the percentage declaratives used for questioning is less than 2%.

In the experiment described in Beun (1989) these remaining utterances were taken out of the original context, potential indicators were removed and the edited versions were compared with the original ones.⁶ Subjects had to indicate the force (question or answer) from the speech signal without contextual information.

⁵The English translations are intended pragmatic equivalences.

⁶Utterances with the overt indicators of Table 4.1 (for example *rising intonation at the end*) were left out because it was feared that the subjects would only pay attention to these clear cases to distinguish the IF.

Table 4.1: Overt question indicators in DQs and their percentage of occurrence related to the total number of DQs in the dialogues.

Question indicator		
rising intonation at the end		48% (37)
the particle <i>toch</i>		4% (3)
"... <i>hè</i> "	("...right")	10% (8)
" <i>u zei</i> ..."	("you said ...")	6% (5)
" <i>u kunt</i> ... <i>zeggen</i> "	("you can tell...")	1% (1)
" <i>u weet</i> ..."	("you know ...")	3% (2)
" <i>u bedoelt</i> ..."	("you mean ...")	1% (1)
" <i>u wilt</i> ..."	("you want ...")	1% (1)
" <i>u hebt</i> ..."	("you have ...")	3% (2)
" <i>oh, dus</i> ..."	("oh, so ...")	1% (1)

It was found that words like *dus* (*so*), *oh* and *en* (*and*) at the beginning of the utterance significantly influenced the responses of the subjects. Removing *ook* (*also*), *niet* (*not*), the pause indicator *uh*, mistakes followed by self-repair and words which indicate uncertainty did not significantly influence the responses of the subjects. A shortcoming in the analysis was that the removal of certain words had the consequence of cutting out certain prosodic aspects as well. We were accordingly unable to discriminate prosodic indicators from textual ones. Therefore, in the experiment described in the next section, the utterances were presented on screen.

4.4 The experiment

4.4.1 The set-up

Twenty Dutch native-speakers took part in the experiment.⁷ Their task was divided into two parts: in one part they had to determine from the (Apple Macintosh) screen whether or not an utterance was originally used as an answer (answer task), in the other part they had to determine

⁷The subjects were of both sexes, all over 18 and mainly students and people from the institute.

whether or not an utterance was used as a question (question task).⁸ One advantage of splitting up the answer and question tasks, instead of simply asking to choose between answer and question, is that it can easily be determined whether the responses in both tasks are related or not. In each part 300 utterances were presented; the utterances of the two parts were equal, only the order differed. Answer task, question task and the two orders were counterbalanced, so that we had 4 subgroups of 5 subjects.

The subjects were told that the utterances presented on the screen were isolated from real-life Schiphol dialogues. So, from the beginning of the experiment they were aware of the domain of discourse.⁹ We did not tell them that only declaratives were presented. They could think for as long as they wanted and after one part a break of about 15 minutes was inserted.

If the response of the subjects was positive they had to push a green button in front of them, if negative they had to push a red button. They always had to make a choice, even in doubtful cases. After pushing one of the buttons a new utterance appeared after one second. All utterances were complete sentences, beginning with a capital letter and were presented without punctuation, except for a very few cases where commas were added to improve legibility.

4.4.2 The corpus of utterances

In the experiment three syntactic categories of declaratives were used, namely a. *S-V-A*, b. *S-V1-A-V2* and c. *A-V-S*, where *S* is the subject, *V* (or *V1* and *V2*) the verb and *A* an adverbial, consisting of one or more elements taken from a set of times and places and their connecting prepositions, e.g., *from Montreal*, *at twelve*, etc. or a subordinate sentence (see e.g., Quirk et al. (1972), de Vooys (1967)). For instance:¹⁰

1. (a) *Het vliegtuig vertrekt om twaalf uur uit Montreal*

⁸The utterances were only based on the declarative questions and answers from the recorded dialogues, so, contrary to the previous experiments, the responses of the subject could not be compared with a real-life utterance.

⁹This was done to avoid the subjects discovering the domain and adapting their responses during the experiment.

¹⁰Some of the English glosses are ill-formed because the Dutch sentences were literally translated.

- (The plane leaves at twelve from Montreal)
- (b) *Het vliegtuig is om twaalf uur gearriveerd*
(The plane is at twelve arrived)
- (c) *Om twaalf uur vertrekt het vliegtuig*
(At twelve leaves the plane)

The subject *S* was chosen from the following set of references:

{*Ik* (I), *U* (you), *hij* (he), *zij* (she), *de trein* (the train), *de bus* (the bus), *de reistijd* (the travel time), *de reis* (the trip), *het vliegtuig* (the plane), *die* (that/those), *dat* (that/those)}

Let us call these utterances *simple utterances*. Next, one or more pragmatic particles were added at arbitrary, but syntactically correct, places to the simple utterances. These particles were taken from the following set:¹¹

{*en* (and), *oh* (oh), *dus* (so), *wel*, *toch*¹², *ook* (also), *niet* (not)}

En and *oh* were only added at the beginning of the utterance. To avoid recognition of the same recurring utterances, *S* and *A* were also varied, e.g.:

2. *Het vliegtuig vertrekt morgenmiddag*
(The plane leaves tomorrow afternoon)
3. *En de trein vertrekt om twaalf uur*
(And the train leaves at twelve)
4. *De bus vertrekt dus om vier uur*
(The bus leaves so at four)
5. *En het vliegtuig vertrekt niet om 14.30 uur*
(And the plane does not leave at 14.30 hours)

¹¹This set was based on the most frequently occurring particles in the recorded dialogue material.

¹²A translation of the words *wel* and *toch* is hard to give and will be omitted.

Here we neglected the influence of the length of the utterance on the interpretation of its IF. It is to be expected, however, that the force will mainly be determined by the meaning of the words. Note that we cannot change *S* in an arbitrary way, otherwise in some cases the utterances cannot be compared on the basis of the added words only. For example, the interpretation of the force of (6) can be completely different from the force of (7) because the subjects were aware of the domain of discourse. They knew, for instance, that (6) could never be uttered by the information clerk and (7) can be uttered by both. So there clearly are asymmetries in the interpretation of the utterances.

6. Ik *vertrek om tien uur*

(I leave at ten)

7. Het vliegtuig *vertrekt om tien uur*

(The plane leaves at ten)

The new utterances were mixed with the simple utterances and presented one by one to the subjects.

Table 4.2: Number of utterances presented in the experiment, classified into syntactic features and the added particle. The numbers between brackets refer to the number of utterances used in the results; utterances with more than one particle (" > 1 particle") were not considered in the results.

	<i>S-V-A</i>	<i>S-V1-A-V2</i>	<i>A-V-S</i>	total
simple ut.	55	8	10	73 (47)
<i>en</i>	19	2	7	28 (22)
<i>dus</i>	30	6	10	46 (25)
<i>toch</i>	30	5	10	45 (24)
<i>ook</i>	7	1	2	10 (5)
<i>niet</i>	9	0	1	10 (9)
<i>wel</i>	8	2	0	10 (7)
<i>oh</i>	23	2	8	33 (21)
> 1 particle	35	4	6	45
total	216	30	54	300 (160)

Table 4.2 gives a survey of the type of utterances presented in the experiment. For instance, 216 utterances had an *S-V-A* syntax, in 30 of

them only the word *dus* was included and 25 of the utterances with *dus* were compared with the simple utterances in the results.

In the experiment the hypothesis stated in section 4.2 was also tested, namely that utterances with mental state or performative verbs (and their restrictions) in the matrix sentence will result in a question interpretation. Therefore the verbs *zeggen* (*say*; 6 utterances), *bedoelen* (*mean*; 5), *willen* (*want*; 6) and *vermoeden* (*suspect*; 6) were put in the second person singular. Although they were part of the 300 utterances, their results were treated separately from the other utterances.

4.5 Results

Before discussing the results, let us introduce some abbreviations for frequently used terms.

(yes)answer: the utterance is interpreted as an answer in the answer task.

(yes)question: the utterance is interpreted as a question in the question task.

(-)utterance: the simple utterance, that is the utterance without certain particles.

(+)utterance: the utterance with added particle.

In Figures 4.1 and 4.2 the percentages of positive responses in the answer and question tasks are shown. These figures show the difference in (yes)answers and (yes)questions respectively between (-)utterances (white rectangle) and (+)utterances (shaded rectangle).

We can see for instance in Figure 4.1 that simple utterances without *en* (*and*) at the beginning were interpreted in 83% of cases as an answer. The same utterances with *en* were interpreted in 56% of cases as an answer. On the other hand, if we return to the question function in Figure 4.2, we see a shift from (-)utterances to utterances with the *en* indicator of 11% to 32%. The shift in the utterances without or with *dus* (*so*) is even more dramatic: in the answer task from 91% to 18%; in the question task from 8% to 83%. The (+)utterances with *en*, *dus*, *toch*

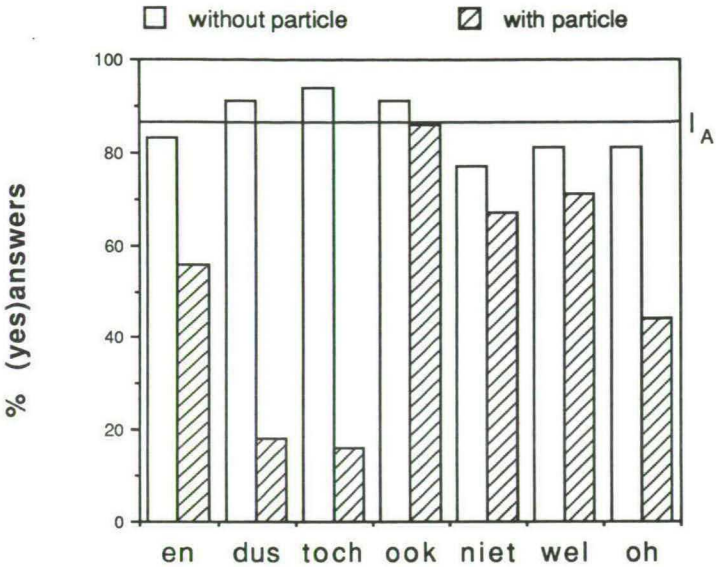


Figure 4.1: The shift of (*yes*)answers as a function of the absence (white rectangle) and the presence (shaded rectangle) of pragmatic particles. Line l_A shows the mean value of (*yes*)answers with respect to the simple utterances.

and *oh* differed significantly from the (–)utterances, in both the answer and question task. (In all cases $\chi^2_{df=1} > 13$, $p < 0.001$)

The total number of responses per particle can be calculated from the numbers between brackets in Table 4.2. For instance, we have 22 utterances with *en*, 22 matching (–)utterances and 20 subjects, so the total number is 880 ($= 2 \times 22 \times 20$).

From Figures 4.1 and 4.2 we can see that the presented (–)utterances were not neutral with respect to a question or answer interpretation. In the answer task 86% of them was interpreted as (*yes*)answer, in the question task 11% was interpreted as (*yes*)question, indicated respectively by line l_A and l_Q . Note that Figures 4.1 and 4.2, although they show complementary results in all cases, do not have to be complements because the answer and question tasks were independent.

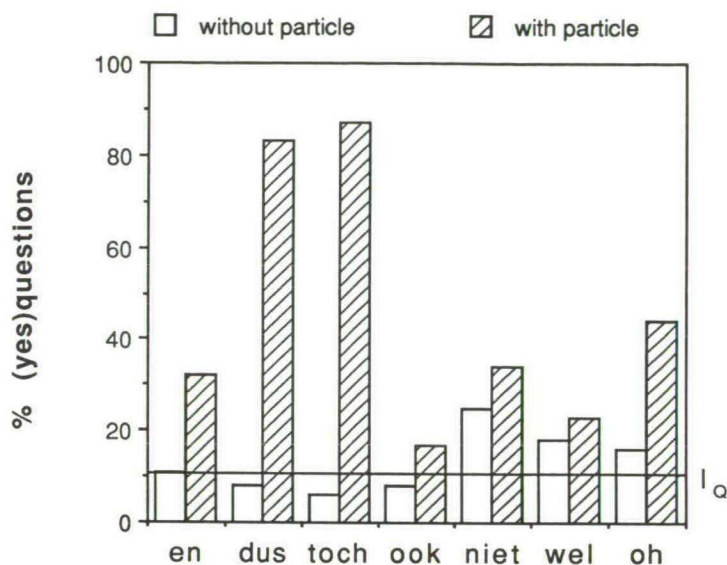


Figure 4.2: The shift of (yes)questions as a function of the absence (white rectangle) and the presence (shaded rectangle) of pragmatic particles. Line l_Q shows the mean value of (yes)questions with respect to the simple utterances.

The results of the performative and mental state verbs are depicted in Table 4.3. The addition of particles hardly influenced the responses and therefore the values in Table 4.3 are the mean values of both (-)utterances and (+)utterances.

Table 4.3: Percentage (yes)answers and (yes)questions as a function of the main verb.

		(yes)answers	(yes)questions
zeggen	(say)	10%	78%
bedoelen	(mean)	7%	93%
willen	(want)	10%	93%
vermoeden	(suspect)	3%	93%

4.6 Discussion

From Figures 4.1 and 4.2 we can see that the simple utterances were not neutral with respect to the answer/question force. Lines l_A and l_Q show that in almost 90% of the cases the simple utterances were interpreted as answers or non-questions. In 75% the topic of the simple utterances was train or airplane information, like:

1. "The train leaves at twelve"

Intuitively it seems very natural to interpret these utterances as an answer. In section 4.2, though, we suggested that, depending on the speaker, (1) could be either an answer or a question. So, why do subjects prefer the answer interpretation?

If we take a closer look at the recorded dialogues we see that almost all answers have the following form: declarative, no special discourse marker (i.e. no rising intonation, no particle, etc.) and complete sentences. On the other hand, only 6% of the DQs (5 out of 77) have the same form as the answers. Therefore, we could say that, if we have to choose between question or answer, every declarative is an answer by default, unless special indicators are added.

The deviation from a 100% answer interpretation of the simple utterances is mainly caused by sentences that were clearly uttered by the information seeker, such as:

2. "I have to be there at eleven in the morning"

So, another criterion was the speaker of the utterance. This was confirmed afterwards by most of the subjects. All subjects were interviewed after the experiment and 80% of them stated that during the experiment they tried to imagine who the speaker could have been, the information clerk or the information seeker.

The subjects also stated that in many cases they had problems making a decision. It is very likely, however, that subjects responded highly consistently in the answer and question tasks, because Figures 4.1 and 4.2 are almost complementary.

The results agree with the experiments described in Beun (1989). It was already noted that cutting out certain words in the acoustic signal removed both prosodic and textual aspects of the utterance. Therefore

it could not be concluded which feature played a decisive role in the subject's responses. The similar results of the experiment described in this paper strongly suggest that prosodic features, other than a rising intonation at the end, played a minor role in the previous experiments. This is supported by the fact that all particles in the latter experiments were not accentuated and formed only a small part of the total speech signal.

This brings us to the next topic, namely how do the particles influence the responses of the subjects? Although all particles influenced the responses in the same direction, that is, a decrease in answer interpretations and an increase in question interpretations when the particles were added, we will concentrate only on the cases where significant differences appeared: *en* (*and*), *dus* (*so*), *oh* (*oh*) and *toch*.

***En* (*and*) at the beginning of the utterance:** In general *en* will be used in Dutch as a conjunction between two propositions or a sequential ordering of two events. In this case the first conjunct is missing. So, here we have two possibilities. First, there is only one "conjunct". In this case the *en* does not represent a conjunction at all. Second, there are two conjuncts but the first conjunct is situated elsewhere. The first solution is not an attractive one, because it would commit us to changing the meaning of *en* drastically and also it would not correspond to the empirical data of the recorded dialogues, since in almost 90% (17 out of 19) of the recorded declaratives with *en*, the *en* linked a previous statement uttered by the dialogue partner.¹³ This link was established by a return to the topic of the first conjunct.

How can the second possibility help us to explain the significant difference in responses in Figures 4.1 and 4.2? First, it might be assumed that any word or morpheme neutral with respect to a question force added at the beginning of an utterance will change the responses of the subjects. At first sight *en* seems quite neutral with respect to a question or answer interpretation, so we have no evidence against this assumption. On the other hand, maybe *en* is not neutral with respect to both interpretations.

¹³The utterance is not necessarily the previous utterance.

From the sentences with mental state verbs (e.g., 'mean' and 'want') we know that subjects take the expert on the topic into account, i.e. declaratives uttered by the non-expert are interpreted as questions. So, if subjects believe that the declarative with *en* at the beginning is uttered by the non-expert, they would prefer a *question* interpretation. But why would subjects believe that these declaratives are uttered by the non-expert?

Again, a closer look at the recorded dialogues is required. In almost all cases *en* at the beginning of a declarative connects the declarative of the speaker with an answer of the dialogue partner. The subjects were told that the utterances always came from the beginning of a speech turn, so they knew that the utterance was not a second part of a conjunction spoken by the same speaker. In our discourse domain an answer is always uttered by the expert on the topic.¹⁴ If the *en* does not connect two arbitrary statements, but two statements about the same topic (see van Dijk (1977)), then the second statement (or rather 'declarative') is always uttered by the non-expert and so, the utterance will be interpreted as a question.

Dus (so): In the recorded dialogues all declarative questions with *dus* were used as *drawing a conclusion* from one or more statements of the dialogue partner and, in some cases, mutual world knowledge. If *dus* is uttered by the one who presents the facts, it is usually done at the end of the same turn in which the facts were presented. On the other hand, if the utterance with *dus* is at the beginning of a turn, then the utterance is mostly uttered by the non-expert as a conclusion from the facts presented by the dialogue partner. So the total utterance will be interpreted as a question.

Toch: According to Pander Maat and Sauer (1986) *toch* focusses on conflicting beliefs and expectations between the dialogue partners during the dialogue. If in cooperative dialogues one of the purposes is to avoid conflicts or to find solutions for conflicts, then the dialogue partner is exhorted by the dialogue situation to respond. So the *conflict* seems to elicit the response and the word *toch* only

¹⁴In other domains of discourse, such as for instance an examination, the questioner can be the expert.

draws attention to the conflict. However, the same can be stated about the accentuated particle *wel*, which often corrects a negation in a previous utterance. From the experiment, it followed that no significant shifts appeared when the particle *wel* was removed and therefore the conflicting situation cannot be the only reason. Hence, beside the adversative element, *toch* also seems to express that the hearer is exhorted to react, which could explain the dramatic shift in the subjects' responses.

Oh: In Dutch *oh* seems to work in the same way as the English *oh*, therefore the function will be discussed from the English particle. Schiffrin (1987) discusses that English *oh* marks different tasks of information management in discourse. She distinguishes four different functions of *oh*: (1) the introduction of a repair unit, (2) as a preface in questions, answers and/or acknowledgements, (3) as a marker of the status of information (e.g., new vs. old information) and (4) the introduction of a shift in subjective orientation (e.g., the intensity of a speaker's commitment to the truth of a proposition). As an overall function *oh* marks a focus of a speaker's attention and marks information as more salient. The particle is often used when locally provided information does not correspond to a speaker's prior expectations and is often followed by a request for clarification and elaboration.

If the subjects are aware of these functions, this can explain the shift of subjects' responses. The question function of the utterance can easily be determined from the particle itself. Note, however, that the shift is not as dramatic as in the case of *dus* and *toch*, which is probably caused by the ambiguous meaning of *oh*. The functions, (3) and (4) and the initiation of an answer and/or acknowledgement in (2) do not suggest any question function at all.

4.7 Conclusion

We hypothesized that in the decision, whether the illocutionary force of a declarative is interpreted as a question or not, three indicators play an important role: prosodic, textual and contextual characteristics of the

utterance. In this paper we have mainly concentrated on the textual indicators. We found that two types of textual indicators are relevant in the recognition of a declarative as a question in isolation, namely:

1. Indicators that determine the expert on the topic of the utterance.
2. Indicators that express conflicting beliefs between the hearer and speaker, and/or surprise of the speaker about a stated proposition.

Examples of the first type are the use of special verbs (e.g., epistemic, performative) in the second person, present or past tense, and the use of particles like *en* at the beginning of the utterance and *dus*. Examples of the second type are the particles *oh* and *toch*.

The results of the visual and the auditory experiments are very similar. Since the subjects in the latter experiment could decide on prosodic and textual information and in the first experiment on textual information only, it is likely that, apart from rising intonation, prosodic characteristics have played a minor role in the recognition of a declarative as a question in spoken utterances. It would be premature to conclude that prosodic characteristics always play a minor role, because in 48% of the recorded DQs a rising intonation was used at the end of the utterance and these utterances were not tested in the auditory experiment. The conclusion is also weakened by the fact that subjects hardly use declarative questions in dialogues where prosodic cues are absent.

It should be stressed that prosodic cues can be more important in languages where textual marking is less often used for questioning (e.g., French, Italian and modern Greek)¹⁵. If the recognition of the question heavily depends on prosodic cues and no syntactic or morphological information is available, it would not only be interesting to know which prosodic cues are used in spoken conversation but also which cues are used in conversation if no prosodic information is available.

From some examples in section 4.2 it followed that the function of the indicators as a reference to the expert can be overruled by contextual cues. In general all the indicators discussed in this paper can be overruled by contextual cues; if contextual cues are insufficient, however, indicators can contribute to a question interpretation of the utterance.

¹⁵This was pointed out by Hartmut Haberland (personal communication).

A point for future research is to determine why people use a declarative instead of an interrogative to ask a question. If a declarative is used to express that the speaker has a certain supposition about the declarative's content, it is to be expected that contextual information will play a crucial role.

Chapter 5

Context and the use of declarative questions

R.J. Beun

abstract

Questions in spoken dialogues are often uttered with a declarative sentence type. Since more than 50% of these questions cannot be recognized as such without contextual features, a speaker must have, at the risk of misunderstanding, special reasons to use a declarative form instead of an interrogative one. To determine the contextual features that contribute to the use of a declarative question, two experiments were carried out. In the experiments dialogues taken from transcriptions of Dutch telephone conversations were presented in printed form to subjects. In the first experiment the preference of the subjects was tested for a declarative or an interrogative form; in the second experiment the subjects had to indicate the certainty of the speaker about the propositional content of the declarative. It was found that preference for a declarative form is low if no information about the content of the question was provided in the dialogue; preference increases if information can be derived from conversational principles or implication, or if the information was literally provided in the dialogue. The outcome correlates significantly with the subjects' responses about the speaker's degree of certainty. Moreover, it is argued that, although verification is an important function of declarative questions, the syntactic form can also be influenced by topic change and rules of politeness.

5.1 Introduction

In spoken information dialogues, almost 20% of questions are put in a declarative form and in more than half of these cases the question function cannot be identified without contextual features (Beun (1989)). Since hearers hardly ever doubt the function of questions in dialogues, they must use contextual knowledge for identification if overt question indicators are absent; the speaker, on the other hand, must be sure that the function will be recognized, so he must count on the contextual knowledge available to the hearer.

Unless special question markers (e.g., intonation patterns, special particles, propositional content) are used, a declarative question (DQ) can be considered to be indirect (Levinson (1983)), and the speaker must have, at the risk of misunderstanding, special reasons to use a declarative (D-form) instead of an interrogative (I-form) as the syntactic form of a question. In this paper we will try to find out what information is communicated by the speaker if a D-form is used and how contextual features influence the use of a D-form of questions in natural-language dialogues.

Contextual knowledge does not only include knowledge about the world, but also knowledge about relevant aspects of the *mental states* of the dialogue participants in terms of intentions, beliefs, expectations, etc. and general principles of cooperative and rational behaviour. Here, mental states will be restricted to the participants' intentions and beliefs, and it is assumed that a mental state can be changed during the dialogue by means of communicative acts performed by the participants. For instance, if a speaker utters a declarative, the hearer may take over the proposition expressed by the declarative unless he has evidence to the contrary, or, if a speaker utters an interrogative, the hearer may come to believe that the speaker wants to know something.

To find out which particular contextual knowledge influences the use of a D-form or an I-form of questions in a dialogue situation, the preference of subjects for one of the two forms was tested in an experiment. In a second experiment the speaker's certainty about the propositional content of the D-form was tested. The type of dialogue will be restricted to so-called *information dialogues* (Bunt (1989a)), where the participants

have the sole purpose of transferring certain factual information. In these dialogues it is not only assumed that the participants behave in a *cooperative* (Grice (1975)) and *rational* (Allwood (1976)) way, but also apply certain rules of *politeness* (Leech (1983)). The domain of discourse will be restricted to the exchange of information about the arrival and departure times of aircraft and trains.

Before we discuss the experiments and their results, let us first focus on some proposed functions of DQs in dialogues.

5.2 The function of declarative questions

Consider the following telephone dialogue between an informant at Amsterdam airport (I) and an information seeker (S):¹

Dialogue A

I: Schiphol Information.

S: Good morning. Next Monday I want to go by plane to Paris,

I: Yes...

S: and I have to be there at about two o'clock in the afternoon. What time do I have to leave to be there in time?

I: Well, the plane leaves at 11.30 and it will arrive at 13.30 and there is another one at ...
no,

You said Saturday?

The italicized utterance by I is an example of a question with a D-form. Here, the use of the declarative as a question is accentuated by the question mark; in spoken dialogues, however, overt question indicators are often omitted and most of the recognition comes from contextual

¹All dialogues considered in this paper were recorded at the Institute for Perception Research in Eindhoven (IPO). In order to focus on the relevant part of the dialogues, some transcription symbols have been omitted from the original transcriptions. Punctuation marks do not correspond to prosodic features and are only added to improve legibility. For more detailed information, see Beun (1985).

cues. Even prosodic characteristics, like a final rising intonation, can be overruled by the circumstances of the utterance (Geluyskens (1987)).

In Beun (1988a) the idea was discussed that the interpretation of the declarative as a question depends on the mutual belief of the hearer and speaker that the hearer is the *expert* on the topic of the utterance. For instance, in "You said Saturday" *S* is both hearer and expert, since *S* usually knows best which acts he has performed, and therefore the utterance may be interpreted as a question.² The belief of the dialogue participants as to who is the expert on the topic can come from the utterance itself or from its circumstances.

It is unclear, however, *why* a D-form was used instead of an I-form. If a speaker asks a question with a declarative sentence type he is typically violating the Gricean cooperative principle (Grice (1975)) and one or more of its corresponding maxims; so the speaker may have special reasons for choosing the declarative form. Note that it is not obvious which maxims are violated. One could think of the *quality* maxim because the speaker does not have enough evidence for his statement. On the other hand, if the speaker thinks that the hearer knows the value of the expressed proposition, he is communicating superfluous information, and therefore violates the *quantity* maxim. One could even argue that the wrong surface structure is used, hence also the *manner* maxim could have been violated.

Intuitively, the DQ in the example mentioned above functions as a verification, i.e. beside signalling to the hearer that the speaker wants certain information, the speaker also expresses a weak belief about the propositional content of the DQ. Another use of DQs (which does not follow from the example above) is associated with the development of the topic during the dialogue (Springorum (1986)). Let us consider both functions more closely.

5.2.1 Declarative questions as verifications

Quirk, Greenbaum, Leech and Svartvik (1972) state that the speaker puts a positive (or negative) *assumption* and a neutral *expectation* in a

²Again, this example is highly context-dependent. Utterances like "You know what time it is" or "You feel sick" are probably more convincing, because a speaker has no direct access to a hearer's mental state and therefore can never be the *expert* on the hearer's mental state.

DQ, and that the casual tone suggests that the speaker takes the answer "yes" (or "no") as a foregone conclusion. This statement is not easily verified, however. If a speaker has a certain assumption about the answer, how then can his expectation be neutral? And, is there any reason to assume that a speaker makes certain assumptions about the content of the answer, except by intuition?

To some extent, the *assumed* belief can be inferred from empirical data. Taking a closer look at the corpus of recorded telephone dialogues, we see that 64 out of 77 DQs (83%) evoked a positive answer from the dialogue partner; in only 5 cases (6%) was the answer negative. Hence, it appears that the questioners have certain beliefs or assumptions about the content of the question, as it seems implausible that they would evoke so many positive responses without these.³

More evidence about the assumed belief comes from the form of repetitions of answers in the dialogues (Beun (1985)). An important scheme of the functional elements in the dialogue structure is the following:

A: - *Question*

B: - *Answer*

A: - *Repetition of the answer*

B: - *Response to the repetition*

It was found that one of the possible functions of the *repetition of the answer* is a *verification* of that answer. The belief about the content of the verification seems to be very strong because the information has previously been stated by the dialogue partner. In all cases where a repetition was a complete sentence, the sentence type was declarative and the repetition evoked a positive response. So, at least in these cases, questions with a declarative sentence type strongly indicate a certain belief of the speaker about the content.

If an answer is repeated by means of a DQ, the information about the content of the DQ is literally provided in the preceding discourse; however, as we can see from the following example, the information may come from other sources as well.

³Although it is tempting to say that the beliefs of both participants correspond, we can only conclude that the belief of the responding person corresponds with the content of the DQ. Whether the content of the DQ corresponds to the belief of the questioner is precisely what we are trying to find out.

Dialogue B

I: Schiphol Information.

S: Good morning. I would like to know the arrival time of the plane from Nice, flight number KL338.

I: *That is today?*

In this case, the information in the DQ that the arrival time refers to the same day as the day of the conversation cannot be derived solely from the semantic content of the utterance by S. The information seems to come from a pragmatic rule which roughly states that, if no information is provided about the day of arrival, the day of the conversation is assumed as long as no evidence to the contrary exists. We will assume that the inference is triggered by the Gricean cooperative principle, since S' utterance is conversationally inadequate with respect to an unequivocal determination of the day of arrival.

So, we can hypothesize that the declarative sentence type of a question in some cases will be caused by a certain belief or assumption about the content of the question and that the origin of the belief may come from different sources. In the experiments we will consider the following origin of information about the content. (In the examples below we will refer to the dialogues enclosed in the appendix.)

- The information was *literally* given by the dialogue partner in the previous discourse or could be inferred by *implication* from a previous utterance of the dialogue partner. An example of this type is dialogue 3a in the appendix.
- The information was derived by *implicature* from Gricean conversational principles (Grice (1975)) such as the *quantity* or the *relevance* maxim.

Implicatures from the quantity maxim may come from the first or the second submaxim, i.e. 'make your contribution as informative as is required for the current purpose of the exchange' and 'do not make your contribution more informative than is required', respectively. An example of the first submaxim is dialogue 5a, an example of the second is dialogue 8a.

The relevance maxim will be restricted to the specific case of a question/answer pair. It will be supposed that the semantic content of an answer is related to the content of the previous question. An example is dialogue 2a.

- No information could be derived from the previous discourse but only from *world knowledge* of the speaker of the target, or the information was not derivable at all. Examples are dialogue 4a and dialogue 9a, respectively.

5.2.2 Declarative questions and topical development

Another use of DQs was found by Springorum (1986). He described Dutch dialogues where a doctor is diagnosing a patient's illness and notes that questions asked by the doctor are often put in a D-form when attention is shifted to another topic in the dialogue. It was not possible to recover the doctor's assumed belief about the content of the DQ from these dialogues, so this might suggest that the function of a D-form in a question may be the announcement of a new topic in the dialogue. This implies that topical aspects may influence the use of a declarative sentence type in questions and therefore we will also take these aspects into account.

In the experiments four types of topical development will be considered: *topic continuation*, *shift*, *recycling* and *change*.⁴

- *Topic continuation* implies that the topic of the previous turn is related to the topic of the DQ. In the dialogues, topic continuation was established in two ways:
 - a. The informant wants elucidation of a question previously asked by the information seeker. An example of this type is dialogue 1a in the appendix.

⁴These types were taken from Gardner (1987). Gardner introduces two more types: *topic introduction* and *reintroduction*. The first concerns the first topic once the initial stage has passed. Since no DQ comes directly after the initial stage this type will not be considered here. The latter concerns a return to a previous topic, whilst the topic of a previous sequence is not related to any other topic in the dialogue (e.g., interruptions). This type did not appear in our dialogues either.

- b. The information seeker wants elucidation of an answer previously given by the informant. An example of this type is dialogue 2a.

In many cases co-referentiality is an important indicator for topic continuation, especially the use of demonstratives which refer to a certain concept mentioned in the previous speech turn.⁵

- *Topic shift* occurs when the topic of the DQ is linked to the previous utterance but broaches a different aspect of the utterance. For instance, the previous utterance is about 'indirect flights' and the DQ is about 'non-stop flights' (e.g., dialogue 12a).
- *Topic change* occurs where the topic of the DQ is unrelated to all previous topics in the exchange. For instance, S asks what time planes arrive from Moskow, I answers the question and next, S asks whether any buses go from Amsterdam to Schiphol airport (e.g., dialogue 6b).
- *Topic recycling* occurs if the topic of the DQ changes with regard to the topic of the previous exchange and continues with regard to earlier exchanges (e.g., dialogue 3b).

5.3 The experiments

Two experiments tested how contextual features influenced the subjects' preference for a D- or I-form and how contextual features influenced the speaker's certainty (indicated by the subjects) about the content of the DQ. In both experiments dialogues were presented in printed form to 24 subjects; all subjects from the first experiment differed from the subjects of the second. The subjects were Dutch native speakers, of both sexes, all over 18 and mainly students and staff members from the institute.

⁵Levinson (1983) argues that co-referentiality, or a set of shared concepts, is not always sufficient to establish topical coherence. In his examples, however, no demonstratives were used and in all cases topic change markers appear, such as "Hey" or "By the way".

5.3.1 General structure of the dialogues

Eighteen dialogues were taken from transcriptions of Dutch telephone conversations (see also the appendix), recorded in a previous experiment (Beun (1985)), between an informant (**I**) from Amsterdam airport (Schiphol) and an information-seeker (**S**). To improve legibility, non-relevant errors and hesitations were removed from the transcriptions. In many cases the dialogue presented was not the whole original dialogue but only a relevant part. The sequential organization of the dialogues used in the experiment was as follows:

- Each dialogue had an initial stage of identification and greeting, for example, "Schiphol Information", "Good morning", and so on. These beginning sequences were added to induce the subjects to think that the only information exchange between **I** and **S** was the information available on paper.
- After the initial stage **S** asked a direct or indirect question; in some cases **S** supplied introductory information about his travel plans between the question and the initial stage.
- No dialogue had a closing section (Schegloff & Sacks (1973)), i.e. sequences such as **A**: "OK", **B**: "OK", **A**: "Bye", **B**: "Bye" had been omitted from the transcriptions. (See also below.)
- Dialogues were relatively short, i.e. the shortest dialogue had 3 speaking turns and the longest had 9 turns including the initial stage.

Each dialogue consisted of two parts, the *contextual part*, where contextual information was provided, and the *target part*, on which the subjects had to make certain judgements. In both experiments two versions of each dialogue were presented: the *original* one, and an *edited* version where information was changed in the contextual or the target part with respect to the semantic content of the target, or the topical relation between both parts.

The target part in the first experiment consisted of two questions, (i) and (ii) (see the example below). One of them was put in a D-form, the other in an I-form. In both cases question-marks were put at the

end. In the second experiment the target part only consisted of the D-form of the first experiment. In this case the question-mark was replaced by a full stop, so that the utterance looked like a statement by I or S. This was done because we were only interested in the subject's judgement about the propositional content of the utterance which is expressed more directly in a statement than a question. All dialogues ended after the target part, so that the subjects had no more information available about the discourse than the dialogue participants at the moment of the target part.

The following example shows a translation in English of two dialogues used in the first experiment, an original and its edited version. The contextual part is represented in typewriter style, the target part in italics.⁶ The first one is the original dialogue.

Dialogue C1

I: Schiphol Information.

S: Good morning, this is H. Next week I am going by plane to Montreal, I don't know the flight number, KL 671 or KL 571. Can you tell me what time I have to catch the train in Den Haag to be in time at Schiphol?

I: Your flight is KL 671.

S: Yes

I: And it will leave at 14.40.

(i) *You would like to come by train?*

(ii) *Would you like to come by train?*

In the second version the information that S wants to go by train to Schiphol is removed from the contextual part:

Dialogue C2

I: Schiphol Information.

⁶In the second experiment, the contextual part remained the same, but the target part was replaced by the utterance "You would like to come by train."

S: Hello, next week I am going by plane to Singapore, I don't know the flight number, LH 410 or LH 510. Can you tell me what time I have to leave Tilburg to be in time at Schiphol?

I: Your flight is LH 510.

S: Yes

I: And it will leave at six in the evening.

(i) *You would like to come by train?*

(ii) *Would you like to come by train?*

In previous experiments (Beun (1988a) and Beun (1989)) it was found that certain particles could influence the interpretation of a D-form as a question. Since the occurrence of these particles could influence the subjects' responses, and since we were interested in the influence of contextual features only, in both experiments particles like *so*, *well* and *oh* were removed from the target sentences without losing relevant information about the semantic content of the sentence. Note that the flight numbers, cities, times and introductions were changed, although the structure of the edited dialogue remains the same. This was done to avoid that the subjects would recognize the intended differences between the original and the edited dialogues.

5.3.2 The dialogues separately discussed

Since it will not be clear in all cases how the information in the dialogues was manipulated, let us pay some attention to each dialogue separately. A survey of the origin of the content information and the topical development of the target part is given in Table 5.1. The appendix provides English translations of the original and the edited dialogues; the target part is taken from the first experiment, so, the declarative and the interrogative question are both represented.

Dialogue 1

In dialogue 1b the information about the target was literally given in the previous discourse. In dialogue 1a I commits an error and it is to be expected that I is less certain about the answer since she failed to recover the correct day.

Dialogue 2

In dialogues 2a and 2b the relevance maxim is applicable, since I's answer should be interpreted in the light of the previous question. Therefore, in dialogue 2a the answer refers to arrival times on Sunday; in 2b the supposition expressed in the target is weakened by the use of the word 'possibly'.

Dialogue 3

In dialogues 3a and 3b the information is literally given by I. In dialogue 3b an intermediate sequence about a different topic was added so that the target can be regarded as a topic recycle.

Dialogue 4

In dialogue 4a the information is not provided in the discourse and may come from world knowledge of the speaker. In dialogue 4b I gives the information that S has to check in one and a half hours before departure. Note that in the first dialogue topic changes with respect to the previous discourse; in the second dialogue topic continues.

Dialogue 5

In dialogue 5a I communicates that she has no information about bus services. By quantity, however, I is supposed to give the strongest available information. So, from this, S may infer that I also has no information about departure times of buses early in the morning.⁷ In dialogue 5b no information was provided about the content of the question.

Dialogue 6

In both dialogues no information is provided in the previous discourse. If any information is available, it may come from world knowledge possessed by the speaker. In dialogue 6b topic changes with respect to the discourse, in dialogue 6a topic shifts from the trip from Tilburg in general to the more specific information about train departure times.

⁷Note that the information cannot be inferred by implication. The fact that I has no information about bus services does not imply that I does not know whether a bus leaves early in the morning.

Dialogue 7

Dialogues 7a and 7b are similar to dialogues 2a and 2b. In dialogue 7a I's answer refers to the arrival time of the plane in the afternoon or the next morning. In dialogue 7b S asked only for flights in the afternoon; however, I's answer is not likely to be meant for the plane in the afternoon since the hour of arrival (9.55) refers to the morning. By means of the second submaxim of quantity it may be derived that the arrival time is meant for the next morning. Note that the dialogue takes place in the afternoon, since S opens with "Good afternoon".

Dialogue 8

In dialogue 8a a question is asked about arrival times without mentioning the day of arrival. In most cases the day of arrival refers to 'today' by the second submaxim of quantity. In dialogue 8b I's question seems very unlikely, unless she has any evidence from the flight number that the plane arrived yesterday, and not today or the next day. In that case, the information may come from world knowledge.

Dialogue 9

In dialogues 9a and 9b no information is provided about S' last question. In 9b I shows at least that she is aware that S has to take an early train.

Dialogue 10

In dialogue 10a S provides implicitly the information in the question that he or she wants to come by train; in dialogue 10b no such information is given.

Dialogue 11

In dialogues 11a and 11b no information is given about S' last question. In 11b, however, S asks about buses from Eindhoven to Schiphol and therefore causes a topical change; in dialogue 11a S asks about a specific aspect of the flight and is therefore labelled as 'topic continuation'.

Dialogue 12

If I is aware that S would prefer a non-stop flight (which is usually the case) then I would have given a more informative answer. From this S

may infer by quantity in dialogue 12b that there are no non-stop flights. In dialogue 12a the same information is provided but **S** asks a question about which no information is given in the previous discourse. Note that in both dialogues topic shifts from indirect flights to non-stop flights.

Dialogue 13

In dialogue 13a **S** may infer from quantity that **I** provided all the necessary information. In 13b no information about **S**' question is provided in the previous discourse.

Dialogue 14

In both dialogues the information about **S**' last question may come from world knowledge. Usually the schedule in the weekend is different, so one may expect a stronger supposition about the content of the question in dialogue 14b. In both dialogues topic shifts from the schedule 'today' to the schedule during the weekend.

Dialogue 15

In dialogue 15a **I** mentions one flight on Saturday and two flights on Sunday, from which **S** may infer by implication that there are three flights in two days. In dialogue 15b explicit information about the day of arrival is left out, but, by relevance, the answer may refer to the two days mentioned before, which implies that there are three flights (or more) in two days.

Dialogue 16

In dialogue 16a it may be inferred by quantity that there is only one flight; in dialogue 16b **I** answers literally that the flight mentioned is the only flight that day.

Dialogue 17

In dialogue 17b **S** asks explicitly for arrival times today and tomorrow, so we may expect by relevance that the answer refers to both days. In dialogue 17a **I** answers that there are three flights a day, from which **S** may infer by the second submaxim of quantity that the answer will also count for tomorrow.

Dialogue 18

In dialogue 18a the information is provided that **S** has to check in one and a half hours before departure. From this **S** may infer by implication that she or he has to arrive at Schiphol about one and a half hours before departure, which is around 13.30. In dialogue 18b no such information is provided in the previous discourse.

5.3.3 The task

Experiment 1

In the first experiment the subjects were told that all dialogues were taken from real-life telephone dialogues and they were asked to guess which form of the target part was originally used in the dialogue, the D- or the I-form. To counterbalance both forms, all dialogues were presented twice, so that both forms were presented equally as (i) and (ii). An advantage of this method was that the consistency of the subjects' responses could also be checked. In all, 72 dialogues ($2 \times 2 \times 18$) were presented in the first experiment.

Experiment 2

The task of the subjects in the second experiment was to judge on a scale from 0 to 4 how certain the speaker (**I** or **S**) of the target sentence was about the content of the sentence. *Very uncertain* was represented by 0, *very certain* by 4. Here, no counterbalance was needed with respect to the target part, so only 36 dialogues were presented to the subjects.

Before we discuss the results, let us first summarize the differences between experiments 1 and 2. The target part of experiment 1 consisted of two questions, a D-form and an I-form. The subjects had to indicate which of the two forms was originally used in the dialogue and the total number of dialogues presented was 72.

The target part of experiment 2 consisted of one statement (the D-form of experiment 1; the question mark was replaced by a full stop). The subjects had to judge the speaker's certainty about the content of the statement and the total number of dialogues presented was 36.

5.4 Results

Table 5.1 shows the results for the 36 dialogues in pairs labelled a & b. The first (a) always denotes the original dialogue; in the second (b) small changes were made. The column *information* shows the source of the belief about the content. Here we have five options:⁸ *world* (knowledge) or *no inf(ormation)*, *relevance* or *quantity*, and *literally* or *implication*.

The column *topic* indicates the topical development of the target part. Here we have four options: *cont(inuation)*, *shift*, *recycl(ing)* and *change*.

Column *exp1* indicates the percentage declaratives that were predicted by the subjects in the first experiment (100% = 48 responses). Dialogues 2, 4, 10, 11, 13, 15, 16 and 17 showed a significant difference between the two versions in the use of declaratives. (In all cases $\chi^2_{df=1} > 4.80$, $p < 0.05$.) Significant differences are indicated by '*'.

The column *exp2* shows the mean degree of certainty scored by the subjects in the second experiment on a scale from 0 to 4. Dialogues 1, 3, 4, 5, 6, 7, 10, 13, 15, 16, 17 and 18 showed a significant difference between the two versions in the degree of certainty (sign test applied over the degree of certainty per subject; in all cases $p < 0.05$). Significant differences are indicated by '*'.

For all pairs of dialogues where both the use of declaratives and degree of certainty showed a significant difference (dialogues 4, 10, 13, 15, 16 and 17), the results show the same behaviour. That is, if the use of declaratives increases, certainty also increases, and vice versa. The hypothesis that the two are uncorrelated can be rejected, with $p < 0.02$. (Here, the sign was applied over the differences in results of the percentage of declaratives and the degree of certainty.)

In Figures 5.1 and 5.2 the average percentage declaratives and the average degree of certainty are successively shown as a function of the source of information. Literal information or information derived by implication is indicated by 'L' (Literal; number of dialogues (n) = 8), information derived from the maxims is indicated by 'I' (Implicature; n = 12), and information derived from world knowledge or no information is indicated by 'N' (No information; n = 15). In both experiments the

⁸There is one exception, however, in the first dialogue where the informant makes a *mistake*. The dialogue was separated from the others because it can hardly be classified in one of the other groups.

Table 5.1: Survey of the origin of information and topical development of the target part for the 18 pairs of dialogues. Column *exp1* indicates the percentage declaratives predicted by the subjects in the first experiment; column *exp2* shows the mean degree of certainty scored by the subjects in the second experiment.

<i>Dial</i>		<i>information</i>	<i>topic</i>	<i>exp1</i>	<i>exp2</i>
1	a	mistake	cont	33	1.1 *
	b	literally	cont	58	3.0 *
2	a	relevance	cont	71 *	2.4
	b	relevance	cont	40 *	2.1
3	a	literally	cont	71	3.5 *
	b	literally	recycl	67	2.9 *
4	a	noinfo	change	40 *	2.5 *
	b	implication	cont	73 *	3.6 *
5	a	quantity	cont	79	1.8 *
	b	noinfo	cont	60	0.5 *
6	a	noinfo	shift	17	3.7 *
	b	noinfo	change	4	2.0 *
7	a	relevance	cont	50	3.3 *
	b	quantity	cont	42	2.6 *
8	a	quantity	cont	48	2.5
	b	noinfo	cont	33	1.9
9	a	noinfo	cont	2	2.3
	b	noinfo	cont	15	2.5
10	a	implication	cont	92 *	3.6 *
	b	noinfo	cont	29 *	1.5 *
11	a	noinfo	cont	71 *	1.8
	b	noinfo	change	2 *	2.1
12	a	noinfo	shift	13	1.6
	b	quantity	shift	27	1.5
13	a	quantity	cont	40 *	3.1 *
	b	noinfo	cont	2 *	1.8 *
14	a	noinfo	shift	35	1.6
	b	noinfo	shift	13	1.7
15	a	implication	cont	71 *	2.9 *
	b	relevance	cont	42 *	1.8 *
16	a	quantity	cont	21 *	1.9 *
	b	literally	cont	67 *	3.4 *
17	a	quantity	cont	48 *	2.2 *
	b	relevance	cont	77 *	2.8 *
18	a	implication	cont	63	3.5 *
	b	noinfo	cont	65	2.9 *

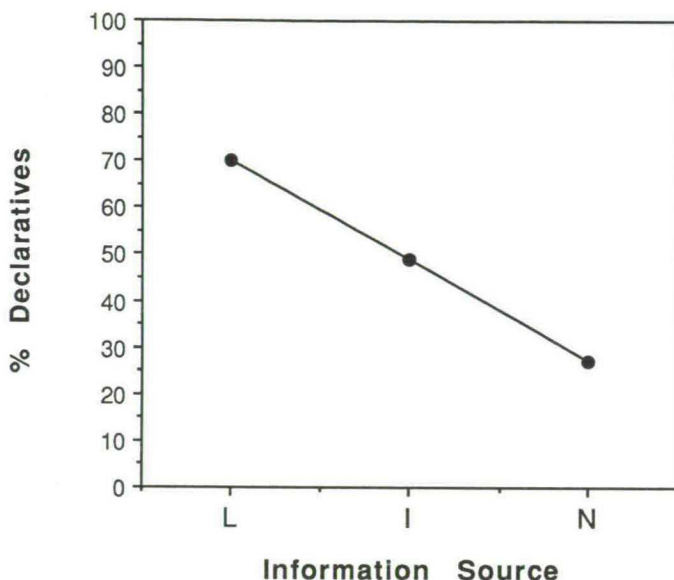


Figure 5.1: The choice of declaratives in percentages as a function of the source of information.

sources of information had significantly different effects (Figure 5.1: LI: $\chi^2_{df=1} = 18.2$, $p < 0.001$, IN: $\chi^2_{df=1} = 28.5$, $p < 0.001$, LN: $\chi^2_{df=1} = 155$, $p < 0.001$. Figure 5.2: LI: $p < 0.001$, IN: $p < 0.005$, LN: $p < 0.001$; in this case the sign test was applied over the mean value of the degree of certainty per subject.)

5.5 Discussion

The results indicate two ways in which the speaker's belief about the content of the DQ is related to the use of a D-form. Firstly, the use of a D-form is significantly related to the degree of certainty indicated by the subjects. When certainty about the content increases, the use of D-forms also increases. Secondly, both the number of D-forms and the degree of certainty show the same behaviour towards the source of information. When we look at the dialogues separately, however, we should be careful in our conclusions. Let us therefore consider a few dialogues

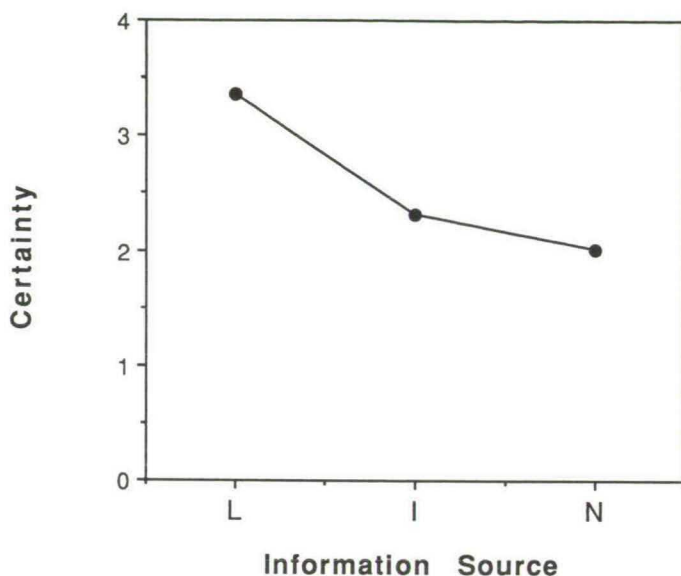


Figure 5.2: The degree of certainty as a function of the the source of information.

more closely.

In dialogues 5a and 5b the use of a D-form was relatively frequent in both dialogues, scoring 79% and 60% respectively. The score for the *certainty* on the other hand is relatively low, 1.8 and 0.5 respectively. So, in this case too, D-form and certainty show the same correlated behaviour, but why do subjects prefer a D-form although the certainty is low compared to other dialogues? Probably the high percentage of D-forms can be explained by the form of the target part, which was the following sentence uttered by S:

You don't know whether a train leaves that early?

Here, a D-form may have been preferred because of politeness. The underlying rule seems to be related to Leech's *approbation maxim*: "minimize dispraise of the other" (Leech (1983)). When an I-form is used instead, the question is more offensive, almost like:

Don't you even know whether a train leaves that early?

Such a question would be impolite in many discourse situations. Of course a lot depends on the sentence intonation pattern, which was not available to the subjects. Another reason could be that an I-form expresses more surprise and from the dialogue it did not follow that **S** had any reason to be surprised. Whatever the explanation may be, the certainty about the propositional content of the DQ is very low and the preference for a D-form is very high, so this case is an exception to our hypothesis that D-forms are only used in cases where certainty is high. Note that it can easily be inferred from the declarative that the utterance is meant as a question, because the hearer is the expert about his own knowledge.

In dialogues 11a and 11b we have a significant decrease in the D-form score (71% and 2% respectively) although certainty was almost equal in both cases (1.8 and 2.1, respectively), so that a direct relation between certainty and D-form does not seem to exist. In this case the result can be explained by an abrupt topic change in 11b. In the contextual part of both dialogues **S** asks which flights are going to Helsinki. **I** answers the question and then **S** continues with the target part (here only represented in D-form):

11a **S**: *The duration of the flight is about three hours?*

11b **S**: *I can go by bus from Utrecht to Schiphol?*

Hence, in 11a **S** continues talking about the flight mentioned by **I**, whereas in 11b, **S** starts talking about the trip from Utrecht to Schiphol. So, it seems to be the case that, in contrast to Springorum's results, an I-form is preferred when a speaker introduces an abrupt topic change.⁹ There is an important difference, however, in the discourse situation of the two kinds of dialogues. In Springorum's dialogues, a doctor is diagnosing the patient's illness. Roughly speaking, this means that the doctor (the expert) is asking questions until he or she has diagnosed the

⁹The similarity in the degree of certainty may be explained by the fact that in both cases no information about the content was provided during the dialogue. This is also the case in dialogues 9 and 14. Note that dialogue 6 is an extreme exception: although the information was not provided during the dialogue, there is a significant difference in certainty (3.7 vs. 2.0).

case;¹⁰ in our dialogues questions were asked by the information-seeker (the non-expert). If the doctor is supposed to be the expert, he can hide his ignorance about the outcome of the answer by asking the question in a D-form. Therefore the form of the utterance could be determined by the discourse situation. In all cases the question function was easily identifiable because the doctor always 'stated' something about the physical condition of the patient, like "*you haven't felt thirsty in the last few months*".

We do not have enough data, however, to verify the relation between topic change and a less preferred use of declaratives. In the experiment there was one case where topic recycled (dialogue 3b) and only in two other cases topic changed, namely dialogues 4a and 6b. It is not possible to compare these directly with 11 because in all cases certainty decreased where the topic changed, which means that the decrease of certainty could be responsible for the decrease in D-forms. In dialogue 6b the D-form is hardly used (4%) and certainty is not high (2.0). Dialogue 4a seems to be in the middle (D-form: 40%, certainty: 2.5). In dialogue 3b, however, the D-form is used in 67% of cases and certainty is relatively high (2.9). Therefore it seems to be the case that if an abrupt topic change occurs, a D-form is preferred where certainty is high and where the evidence comes literally from the discourse.

It is difficult, however, to compare dialogues which are not grouped in pairs, because not everything can be explained from the parameters in Table 5.1. In different dialogues entirely different inferences are usually made to arrive at some sort of belief about the content of the statement. A useful comparison should take account of these different inferences. Note for instance that in dialogue 6a the highest certainty is reached (3.7) although the use of D-forms is only 17%. On the other hand, in dialogue 11a the certainty is 1.8 and the use of D-forms is 71%. One could suggest that the belief scale is not reliable because no fixed or clear-cut concept of *belief* is involved. However, certainty increases (or decreases) significantly when information is added (or deleted) with re-

¹⁰Note that the same structure often occurs in natural-language human-computer dialogues. The computer is asking questions, according to some sort of tree-structure, until it has enough information to provide an answer (see e.g., van Katwijk, van Nes, Bunt, Muller and Leopold (1979)).

spect to the content of the utterance. (See dialogues 4, 5, 10, 15, 16, 17 and 18.) Therefore, the outcome of the certainty scale seems reasonably reliable and useful in cases where no information is added or deleted in the contextual part.

In the results we have seen a significant covariation between the degree of certainty and the source of information. The information was divided into three parts: 1. literally in the text or implication, 2. implicature and 3. world knowledge or no information. Clearly, the classification should be refined in some cases since world knowledge may cause a strong belief about the proposition expressed in the target. An example of this can be found in dialogue 6a. Some of the subjects confronted afterwards with the results stated that "everybody knows that there is a train around 11.30 from Tilburg". Of course, world knowledge is influenced by the place where people live and is also culturally determined. On the other hand, belief inferred by implication may be very low if the inference is 'too difficult' (see Noordman & Vonk (1987)).

It is unclear, however, why the use of declaratives in 6a is so low (17%). The explanation that the information does not come from the discourse is insufficient, since the use of D-forms in, for instance, dialogue 11a is very high (71%). A suggestion could be that certain syntactic constructions are unsuitable for a declarative question; here, "There is ..." or "There are ...".¹¹ Note in this connection the relatively low use of declaratives in dialogues 9a (2%), 9b (15%), 12a (13%) and 12b (27%) which have the same constructions.

Turning to dialogue 10b (the edited dialogue C2 from the example above), we see that in 29% of cases a D-form is preferred, although the information about the content is not mentioned in the text. The degree of certainty (1.5) also suggests that there must be some weak belief about the content. If no information is mentioned in the text, the information must be inferred from already existing world knowledge. The inference could run along the following lines.

1. S says that he wants to set out from Tilburg.
2. S does not say how he will go to Schiphol.

¹¹In Dutch: "Er is ..." or "Er zijn ..."

3. There are only two ways to get from Tilburg to Schiphol (within a limited time), namely by train or by car.
4. **S** is probably not going by car because he knows how fast he drives and therefore it would be easier for **S** than for **I** to determine the duration of the travel time from Tilburg to Schiphol.
5. Therefore **I** thinks that **S** will probably go by train.

In dialogue 10a the I-form sounds more redundant, because the information was already provided in the course of the dialogue. However, the use of an I-form is not wrong; the I-form sounds at the most a little impolite, as if no attention had been paid to what was said before. It can be concluded about all uses of D-forms in questions, especially when the belief about the content comes from certain background information, that the D-form can be replaced by an I-form without affecting the dialogue too much. But of course not the other way around: an I-form cannot be replaced by a D-form, without the risk of misunderstanding the question function and the corresponding speaker's mental state.

5.6 Conclusion

From the experiments it follows that a significant relation exists between the use of a D-form as a syntactic characteristic of a question and the speaker's belief about the content of the question. It cannot be concluded, however, that a strong belief automatically causes a declarative form to be used and a weak belief an interrogative form.

A D-form is used in particular in those cases where information has already been provided in the dialogue and where the speaker doubts certain elements of the information given; the function of these utterances is typically verificative. If the information source is outside the dialogue (e.g., world knowledge) a D-form can always be replaced by an I-form, without affecting the course of the dialogue.

When attention is shifted to another topic in the dialogue, the use of D-forms decreases in those cases where belief about the content is weak. In cases of strong belief, topic change hardly influences the use of D-forms.

Sometimes a D-form is preferred when hardly any belief about the content of the DQ is present, especially in those cases where certain rules of politeness conflict with the use of an I-form. These D-forms can only be used, however, when they are semantically easy to identify as questions, so that no mistakes can be made about the question function of the declarative.

An important question still to be answered is how the speaker's belief can be inferred from contextual features. The inference is usually very complex, especially when world knowledge is involved in the derivation. The inference above, for example, where **I** concludes that **S** will probably go by train, is by no means explicit; in this case one should also include knowledge about times, distances, speed, cars, trains, rational behaviour, and so on. The exact inference scheme would be very complex, which makes the prediction of a certain belief very unreliable. Indeed, this is of no concern to the hearer; he only identifies the belief from the use of a declarative as a question, without bothering about the source of the belief. But even in very simple cases, that is, when the information is provided in the dialogue, the available formal methods of describing dialogues and action theory are not adequate to infer this belief.

Appendix

Dialogue 1a

- I: Schiphol Information.
- S: Good morning. Next Monday I want to go by plane to Paris,
- I: Yes ...
- S: and I have to be there at about two o'clock in the afternoon. What time do I have to be there to arrive in time?
- I: Well, the plane leaves at 11.30 and it will arrive at 13.30 and there is another one at ... no,
(i) *You said Saturday?*
(ii) *Did you say Saturday?*

Dialogue 2a

- I: Schiphol Information.
- S: Hello, can you roughly tell me what time the planes arrive from Munich on Sunday and possibly on Saturday?
- I: Just a moment, please ...
- I: Yes, a plane arrives at 11.50.
- S: (i) *That is on Sunday?*
(ii) *Is that on Sunday?*

Dialogue 1b

- I: Schiphol Information.
- S: Good morning. Next Monday I want to go by plane to Paris,
- I: Yes ...
- S: and I have to be there at about two o'clock. What time do I have to be there to arrive in time?
- I: Well, the plane leaves at 11.30 and it will arrive at 13.30 and there is another one at ... no,
(i) *You said Monday?*
(ii) *Did you say Monday?*

Dialogue 2b

- I: Schiphol Information.
- S: Hello, can you roughly tell me what time the planes arrive from Munich on Sunday and possibly on Saturday?
- I: Just a moment, please ...
- I: Yes, a plane arrives at 11.50.
- S: (i) *That is also on Saturday?*
(ii) *Is that also on Saturday?*

Dialogue 3a

I: Schiphol Information

S: Hi, can you tell me when
planes arrive from Lyon in
Amsterdam, during the whole
week?

I: Yes, just a moment ...

I: A plane arrives at 9.55, but
not in the weekend.

S: (i) *That's the whole week but
not in the weekend?*
(ii) *Is that the whole week but
not in the weekend?*

Dialogue 3b

I: Schiphol Information

S: Hi, can you tell me when
planes arrive from Lyon in
Amsterdam, during the whole
week?

I: Yes, just a moment ...

I: A plane arrives at 9.55, but
not in the weekend.

S: And these are the only
flights?

I: Yes.

S: Do buses leave from Eindhoven
to Schiphol?

I: Yes, they do.

S: (i) *That was the whole week
but not in the weekend?*
(ii) *Was that the whole week
but not in the weekend?*

Dialogue 4a

- I: Schiphol Information.
- S: Good morning, I would like to know what time the planes leave from Amsterdam to Paris, in three days.
- I: One moment, please.
- I: So, that is on Sunday. Then there are several planes. Shall I mention them all?
- S: Yes, please.
- I: There is a plane at 8.05, at 9.50, at 10.25, at 14.25 and at 17.05.
- S: 8.05, 9.50, 10.25, 14.25 and 17.05.
- I: Yes.
- S: (i) *I have to be at Schiphol one-and-a-half hours before departure time?*
(ii) *Do I have to be at Schiphol one-and-a-half hours before departure time?*

Dialogue 4b

- I: Schiphol Information.
- S: Good morning, I would like to know what time the planes leave from Amsterdam to Paris, in three days.
- I: One moment, please.
- I: So, that is on Sunday. Then there are several planes. Shall I mention them all?
- S: Yes, please.
- I: There is a plane at 8.05, at 9.50, at 10.25, at 14.25 and at 17.05 and you have to check in one-and-a-half hours before departure.
- S: 8.05, 9.50, 10.25, 14.25 and 17.05.
- I: Yes.
- S: (i) *I have to be at Schiphol one-and-a-half hours before departure time?*
(ii) *Do I have to be at Schiphol one-and-a-half hours before departure time?*

Dialogue 5a

- I: Schiphol Information.
- S: Good morning, H.B. speaking.
Are there any bus services
from various places to
Schiphol?
- I: Yes, these are ordinary KLM
buses.
- S: What time do they leave from
Eindhoven and can I use them
when I want to pick someone
up and didn't book myself?
- I: That is no problem, but I
don't have any time schedules
about buses here. In that
case, you have to call
another number.
- S: (i) *You don't know whether
they leave early in the morn-
ing?*
(ii) *Don't you know whether
they leave early in the morn-
ing?*

Dialogue 5b

- I: Schiphol Information.
- S: Good morning, H.B. speaking.
Are there any bus services
from various places to
Schiphol?
- I: Yes, these are ordinary KLM
buses.
- S: What time do they leave from
Eindhoven and can I use them
when I want to pick someone
up and didn't book myself?
- I: That is no problem, they leave
every hour from Eindhoven.
- S: (i) *You don't know how long
they take?*
(ii) *Don't you know how long
they take?*

Dialogue 6a

- I: Schiphol Information.
S: Good morning, R.A. speaking.
Next Thursday, I would like to go to Montreal. I don't know the flight number, is that KL 671 or 571?
I: That is KL 671.
S: 671?
I: Yes.
S: And what time do I have to leave from Tilburg by train to catch that flight, do you have any idea about that?
I: Well, your plane leaves at 14.40 and you have to check in one-and-a-half hours before and the trip from Tilburg takes about one-and-a-half hours. So, if you leave three hours before ...
S: (i) *There is a train leaving at 11.30 from Tilburg?*
(ii) *Is there a train leaving at 11.30 from Tilburg?*

Dialogue 6b

- I: Schiphol Information.
S: Good morning, R.A. speaking.
Next Thursday, I would like to go to Montreal. I don't know the flight number, is that KL 671 or 571?
I: That is KL 671.
S: 671?
I: Yes.
S: And what time do I have to leave from Tilburg by train to catch that flight, do you have any idea about that?
I: Well, your plane leaves at 14.40 and you have to check in one-and-a-half hours before and the trip from Tilburg takes about one-and-a-half hours. So, if you leave three hours before ...
S: (i) *Special KLM buses leave from Den Haag to Schiphol?*
(ii) *Do special KLM buses leave from Den Haag to Schiphol?*

Dialogue 7a

- I: Schiphol Information.
 S: Good afternoon, I have a question about the arrival time of planes from Lyon. I am expecting someone who arrives this afternoon or tomorrow. What time do planes arrive from Lyon?
 I: Just a moment, please.
 I: There is a plane at 9.55.
 S: (i) *That is tomorrow morning?*
 (ii) *Is that tomorrow morning?*

Dialogue 7b

- I: Schiphol Information.
 S: Good afternoon, I have a question about the arrival time of planes from Lyon. I am expecting someone who arrives this afternoon. What time do planes arrive from Lyon?
 I: Just a moment, please.
 I: There is a plane at 9.55.
 S: (i) *That is tomorrow morning?*
 (ii) *Is that tomorrow morning?*

Dialogue 8a

- I: Schiphol Information.
 S: Good morning, I would like to know the arrival time of the plane from Nice, flight number KL 338.
 I: (i) *That is today?*
 (ii) *Is that today?*

Dialogue 8b

- I: Schiphol Information.
 S: Good morning, I would like to know the arrival time of the plane from Nice, flight number KL 338.
 I: (i) *That was yesterday?*
 (ii) *Was that yesterday?*

Dialogue 9a

- I: Schiphol Information.
S: Good morning, this is F.D.
Next week, Tuesday, a plane
will be leaving for Prague.
That is the KL 281 or KL 282.
What time does that plane
leave?
I: You said Tuesday?
S: Yes.
I: The plane leaves at 9.25 and
it is the KL 281.
S: Then I would like to have a
connection with the train
from Tilburg. What time do I
have to catch the train in
Tilburg?
I: Yes, you have to check in
one-and-a-half hours before
and the train takes about one
hour and forty minutes.
S: (i) *There is a train that leaves
that early?*
(ii) *Is there a train that leaves
that early?*

Dialogue 9b

- I: Schiphol Information.
S: Good morning, this is F.D.
Next week, Tuesday, a plane
will be leaving for Prague.
That is the KL 281 or KL 282.
What time does that plane
leave?
I: You said Tuesday?
S: Yes.
I: The plane leaves at 9.25 and
it is the KL 281.
S: Then I would like to have a
connection with the train from
Tilburg. What time do I have
to catch the train in Tilburg?
I: Yes, then you have to catch an
early train. You have to be
there at about eight and the
train takes about one hour and
forty minutes.
S: (i) *There is a train that leaves
that early?*
(ii) *Is there a train that leaves
that early?*

Dialogue 10a

I: Schiphol Information

S: Good morning, this is H.K.
Next week I am going by plane
to Montreal, I don't know the
flight number, KL 671 or KL
571. Can you tell me what time
I have to catch the train in
The Hague to be in time at
Schiphol?

I: Your flight is KL 671.

S: Yes.

I: And it will leave at 14.40
(i) *You would like to come by
train?*
(ii) *Would you like to come
by train?*

Dialogue 11a

I: Schiphol Information.

S: Hello, this is G.M. I have to
go to Helsinki, from Amsterdam.
Can you tell me which flights
leave next Sunday?

I: Just a moment.

I: Yes, there are several
flights. One that leaves at
9.10, one at 11.10 and one at
17.30.

S: (i) *The flight takes about
three hours?*
(ii) *Does the flight take about
three hours?*

Dialogue 10b

I: Schiphol Information.

S: Good morning, this is H.K.
Next week I am going by plane
to Montreal, I don't know the
flight number, KL 671 or KL
571. Can you tell me what time
I have to leave The Hague to be
in time at Schiphol?

I: Your flight is KL 671.

S: Yes.

I: And it will leave at 14.40
(i) *You would like to come by
train?*
(ii) *Would you like to come
by train?*

Dialogue 11b

I: Schiphol Information.

S: Hello, this is G.M. I have to
go to Helsinki, from Amsterdam.
Can you tell me which flights
leave next Sunday?

I: Just a moment.

I: Yes, there are several
flights. One that leaves at
9.10, one at 11.10 and one at
17.30.

S: (i) *I can go by bus from Eind-
hoven to Schiphol?*
(ii) *Can I go by bus from
Eindhoven to Schiphol?*

Dialogue 12a

- I: Schiphol Information.
- S: Hello, this is H.P. I have to go to Helsinki, from Amsterdam. Can you tell me which flights leave next Sunday?
- I: Just a moment.
- I: Yes, there are several flights. One that leaves at 9.10, one at 11.10 and one at 17.30.
- S: The flight takes about three hours?
- I: You will arrive at 13.25 if you take the first one. So that is about four hours.
- S: Four hours?
- I: Yes, that's because of the stops.
- S: (i) *There is also a non-stop flight?*
(ii) *Is there also a non-stop flight?*

Dialogue 12b

- I: Schiphol Information.
- S: Hello, this is H.P. I have to go to Helsinki, from Amsterdam. Can you tell me which flights leave next Sunday?
- I: Just a moment.
- I: Yes, there are several flights. One that leaves at 9.10, one at 11.10 and one at 17.30.
- S: The flight takes about three hours?
- I: You will arrive at 13.25 if you take the first one. So that is about four hours.
- S: Four hours?
- I: Yes, that's because of the stops.
- S: (i) *There is no non-stop flight?*
(ii) *Is there no non-stop flight?*

Dialogue 13a

I: Schiphol Information.

S: Hello, I have to pick someone up who's arriving by plane from Dublin, in two days. Can you tell me something about arrival times of those flights?

I: Just a moment.

I: There is a flight at 8.00 in the morning and 8.45 in the evening.

S: (i) *These are the only flights?*
(ii) *Are these the only flights?*

Dialogue 13b

I: Schiphol Information.

S: Hello, I have to pick someone up who's arriving by plane from Dublin, in two days. Can you tell me something about arrival times of those flights?

I: Just a moment.

I: There is a flight at 8.00 in the morning and 8.45 in the evening.

S: (i) *There are also other flights?*
(ii) *Are there also other flights?*

Dialogue 14a

I: Schiphol Information.

S: Hello, J. speaking. Can you tell me what time the plane from Munich arrives?

I: Yes, today or ...?

S: Yes.

I: Let me see.

S: Sure.

I: There is one at 11.50, 16.55 and 21.50.

S: Yes, (i) *The schedule in the week-end is the same?*
(ii) *Is the schedule in the weekend the same?*

Dialogue 14b

I: Schiphol Information.

S: Hello, J. speaking. Can you tell me what time the plane from Munich arrives?

I: Yes, today or ...?

S: Yes.

I: Let me see.

S: Sure.

I: There is one at 11.50, 16.55 and 21.50.

S: Yes, (i) *The schedule in the week-end is different?*
(ii) *Is the schedule in the weekend different?*

Dialogue 15a

I: Schiphol Information.

S: Hello, I would like to have some information. What's the arrival time of airplanes from Dublin, roughly?

I: Well, it depends on the day of the week of course. What day would you like to know?

S: Saturday and Sunday.

I: Saturday and Sunday. On Saturday there is one at 11.45 and Sunday at 20.05 and 16.15.

S: (i) *That's three flights in two days?*
(ii) *Is that three flights in two days?*

Dialogue 15b

I: Schiphol Information.

S: Hello, I would like to have some information. What's the arrival times of airplanes from Dublin, roughly?

I: Well, it depends on the day of the week of course. What day would you like to know?

S: Saturday and Sunday.

I: There is one at 11.45, at 20.05 and at 16.15.

S: (i) *That's three flights in two days?*
(ii) *Is that three flights in two days?*

Dialogue 16a

- I: Schiphol Information.
- S: Good morning, A. speaking. I want to ask you whether you know anything about arrival times of airplanes from Lyon
...
- I: Sure.
- S: on Friday, next Friday.
- I: Just a moment.
- I: There is a flight at 9.55 in the morning.
- S: (i) *That is the only flight that day?*
(ii) *Is that the only flight that day?*

Dialogue 17a

- I: Schiphol Information.
- S: Hello, D.R. speaking. I would like to know how many flights arrive from Munich, and their arrival time, please.
- I: Just a moment.
- I: There are three flights a day. One that arrives at 11.50, one at 16.55, and one at 21.50.
- S: (i) *That is today and tomorrow?*
(ii) *Is that today and tomorrow?*

Dialogue 16b

- I: Schiphol Information.
- S: Good morning, A. speaking. I want to ask you whether you know anything about arrival times of airplanes from Lyon
...
- I: Sure.
- S: on Friday, next Friday.
- I: Just a moment.
- I: There is only a flight at 9.55 in the morning.
- S: (i) *That is the only flight that day?*
(ii) *Is that the only flight that day?*

Dialogue 17b

- I: Schiphol Information.
- S: Hello, D.R. speaking. I would like to know how many flights arrive today and tomorrow from Munich, and their arrival time, please.
- I: Just a moment.
- I: There are three flights a day. One that arrives at 11.50, one at 16.55, and one at 21.50.
- S: (i) *That is today and tomorrow?*
(ii) *Is that today and tomorrow?*

Dialogue 18a

I: Schiphol Information.

S: Hello this is R.J. I booked a flight to Los Angeles for next week, Tuesday. I don't know, was it KL402 or KL 601?

I: KL 601.

S: KL 601. And what time does it leave?

I: At 14.50.

S: How long before do I have to be at Schiphol?

I: You have to check in one-and-a-half hours before.

S: (i) *That means that I have to be there around 13.30?*
(ii) *Does that mean that I have to be there around 13.30?*

Dialogue 18b

I: Schiphol Information.

S: Hello this is R.J. I booked a flight to Los Angeles for next week, tuesday. I don't know, was it KL402 or KL 601?

I: KL 601.

S: KL 601. And what time does it leave?

I: At 14.50.

S: (i) *That means that I have to be there around 13.30?*
(ii) *Does that mean that I have to be there around 13.30?*

Chapter 6

Context-change and communicative acts

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abstract

Communicative acts in natural language dialogues can be regarded as intentional acts performed by a dialogue participant to influence the relevant aspects of the mental state of a recipient. In this paper a framework is discussed for deriving the beliefs and intentions of a speaker from the performance of a certain act. To this end, the communicative act is expressed in terms of prosodic and textual features of the utterance and connected by means of default rules to the conditions that must be fulfilled by a speaker in order to perform the act felicitously. These conditions are expressed in terms of the beliefs and intentions of the speaker and may be compared with Searle's felicity conditions on speech acts. It is argued, though, that some felicity conditions can be derived from a formalization of general principles of rational and cooperative behaviour in information dialogues.

6.1 Introduction

In Levinson (1983) it is argued that a promising approach for speech act theory would be one in which speech acts are characterized in terms of their context-changing effects. In this approach (Isard (1975); Stalnaker (1978); Gazdar (1981); Bunt (1989a)) context is limited to mental states

of the participants (in terms of beliefs, expectations, wants, intentions, etc.) and an illocutionary act is taken as a function that changes one context into another. For instance, the performance of a *promise* can cause a change in a speaker's 'mental' state from one in which he is not committed to a certain future act (context K) into one in which he is (context K'). An *order* changes a context from one in which a hearer is not required by a speaker to do a future act into one in which the hearer is so required.

In Bunt (1989a) the idea of a context change is formalized and the effects of a *communicative act*¹ (CA) in a dialogue situation are represented as follows:

$$(1) \quad K = \langle K_x, K_y \rangle \xrightarrow{CA} K' = \langle K'_x, K'_y \rangle$$

where K'_x and K'_y are the respective new mental states of the agents x and y resulting from the communicative act. The CA is viewed as a function from a context (i.e. the context before the performance of the act) to a new context (i.e. the context after the performance of the act). In other words, $CA(K) = CA(\langle K_x, K_y \rangle) = \langle K'_x, K'_y \rangle = K'$, which agrees with Gazdar's proposal (Gazdar (1981)), where *illocutionary acts* are partial functions from contexts into contexts.

Although the 'context-change' approach of speech acts seems to offer an attractive formal treatment of mental state changes of dialogue participants, there are still many problems to be solved (see e.g., Levinson (1983)). In this paper, we will concentrate on one of these problems, namely how relevant parts of the speaker's mental state can be linked to the linguistic features of the utterance and how a hearer can recognize this state from the speaker's utterance. To answer these questions, we will first go into Bunt's theory in more detail and we will illustrate certain aspects of the theory. In line with Bunt, we will assume that recognition of the act implies recognition of its felicity conditions (i.e. the conditions that must be satisfied by a speaker's mental state in order to perform the act). Next, a belief and intention framework will be sketched to identify the felicity conditions of a certain utterance from its prosodic, textual and contextual features. This framework is based on

¹The notion of 'communicative act' is taken from Allwood (1976) as opposed to 'speech act' to broaden the interactive media.

an application of default rules and is amply inspired by Perrault's (1989) work on an application of default logic in speech act theory.

We will presume that a speaker's intention is always to make something true in a certain state of affairs. For instance, a speaker wants a hearer to believe a proposition or wants a hearer to believe that the speaker wants to know something. To achieve this, a speaker plans an utterance (see e.g., Appelt (1981); Pollack (1989) on the planning of utterances) and tries to compose a sentence with certain syntactic and semantic characteristics.

The other side of this phenomenon is, how can a hearer infer the intentions of the speaker? In other words, what strategy does a hearer use to discover the speaker's intentions from an utterance and its circumstances. Previous studies (e.g., Allen & Perrault (1980); Kautz (1989)) usually concentrate on the recognition of the speaker's plan, in terms of goals and future actions, but are hardly based on linguistic knowledge. In this paper it is not our aim to give a plan-based analysis of the recognition of the goals of a speaker; instead, we will concentrate on the identification of a communicative act or, more precisely, a speaker's intended information transfer, from the linguistic features of the utterance.

6.2 Communicative acts as context-changing functions

In Bunt's theory (1989a), in line with Gazdar (1981) and Searle (1969), a communicative function is applied to a (propositional) content c , yielding a communicative act: $CF(c) = CA$. Successful communication is accomplished if the felicity conditions, $FC_{CA}(c)$, of the communicative act are recognized by the recipient and if the conditions become mutual belief (MB),² for if the recipient understands the communicative act, he knows the preconditions that go with it and he therefore believes that the speaker's mental state fulfills the conditions to perform the act. If, on the other hand, the speaker believes that he is observed by the re-

²Bunt suggests building in two kinds of belief, a strong and a weak version (respectively, *know* and *suspect*), to describe the effects on the mental states of the participants. Since the difference between these two kinds of belief plays no role in this section, they will fuse into one modal belief operator (B).

recipient, he will assume, if there is no evidence to the contrary, that the recipient believes that the speaker fulfills the preconditions, and so on. So, the added information after the performance of the speech act is:

$$(2) \quad MB_{x,y}FC_{CA}(c)$$

That is, after the communicative act CA with preconditions $FC_{CA}(c)$, the agents x and y mutually believe that the preconditions hold. In other words, what an utterance communicates is its felicity conditions.

As we have seen already, CA was treated as a function from the ‘old’ context to the ‘new’ context:³ $CA(K) = K'$. The contextual change caused by the speech act CA can be written as:

$$(3) \quad CA(K) = \text{update}(K, \{MB_{x,y}FC_{CA}(c)\})$$

Here an *update* function is introduced which contains two arguments: a. the old mental states of the agents and b. a set of beliefs with which the old mental state should be updated. Bunt argues that, in general, consistency maintenance and revision of mental states should be taken into account (see also Bunt (1989b)), but that in the simplest case these beliefs can be added to the already present state, that is:

$$(4) \quad CA(K) = \langle K_x \cup \{B_x MB_{x,y}FC_{CA}(c)\}, \\ K_y \cup \{B_y MB_{x,y}FC_{CA}(c)\} \rangle$$

Simply adding propositions to a previous context is inadequate in most cases, since new propositions can influence old ones. Clearly, some of these propositions play an active part during the dialogue (‘memory’) and some are more volatile. This can be modelled by the addition of sequential or temporal aspects (see section 6.5.1).

Bunt gives a taxonomy of communicative functions, based on three different types of intentions that may underly communicative acts in information dialogues: 1. a speaker wants to know something, 2. a speaker wants to make known something, or 3. a speaker knows that the hearer wants to know something. The functions are represented in a hierarchical structure, indicating that one function is more specific than the other in terms of felicity conditions. For instance, a *check* is more specific

³It should be noted that CA is a partial function, because it can only be applied to contexts where one of the participants fulfills the preconditions to perform the speech act.

than a *yes/no-question* because the *check* has the extra condition that the speaker has a supposition about the content of the utterance.

An important issue still to be addressed is how linguistic features of utterances correspond to communicative functions. An obvious linguistic candidate that discloses the function is the appearance of an explicit performative in the utterance. In natural dialogue, however, performatives are rarely used and it is not to be expected that a one-to-one relation will ever be found between sentence features and the meaning of performative verbs (see e.g., Huddleston (1976); Levinson (1983)); the relation will especially be hampered by the influence of contextual features.

Here in line with Cohen and Levesque (1989b), we will avoid illocutionary labelling and attempt to determine the attitudes directly from the linguistic features of the utterance. Communicative functions will be expressed in terms of observable features of the utterance and only those features will be taken into account that contribute to revealing particular attitudes of the speaker, in terms of belief and intentions, towards a certain proposition. For that purpose, a framework will be introduced to represent beliefs, intentions and actions of an agent. Communicative acts will be considered as 'normal' actions, i.e. intentionally performed to change certain aspects of the world. To represent the consequences of a communicative act, we will use Perrault's application of default logic to speech act theory. In particular, default rules will be used to include contextual dependency and to reason without complete knowledge.

6.3 A framework for representing communicative acts

6.3.1 A definition of the language

To represent that an agent performs actions and has certain beliefs and intentions, we will introduce a language L . The expressions $DO_x\alpha$, B_xp , WB_xp , and I_xp are of type *Proposition*. They are read as ' x performs action α ', ' x believes that p ', ' x has a weak belief that p ' and ' x intends to make true that p ', respectively. α is of type *Action*, $Obs(x)$ is of type *Action* denoting the action of observing the agent x . Weak belief (*WB*)

is included to express people's uncertainty about some proposition and is mainly used in relation to verifications (Bunt (1989a); Beun (1988b)). $\bar{B}_x p$ will be used as a shorthand notation for $B_x p \vee B_x \neg p$, and can be read as 'x has a belief about p'.

We will assume that belief (B) possesses the properties of the standard weak S5 axioms (see e.g., Hughes & Cresswell (1968)):

Consistency	$\vdash B_x p \rightarrow \neg B_x \neg p$
Closure	$\vdash B_x p \& B_x (p \rightarrow q) \rightarrow B_x q$
Negative Introspection	$\vdash \neg B_x p \rightarrow B_x \neg B_x p$
Positive Introspection	$\vdash B_x p \rightarrow B_x B_x p$

These rules are closed under the principle:

Necessitation If $\vdash p$ then $B_x p$

where p is an axiom of (standard) propositional logic.

Note that the axiom $B_x p \rightarrow p$ is not included because we want to make it possible that an agent has incorrect information about the 'real' world. To indicate a common belief of two agents, we will use mutual belief $MB_{xy} p$ (which is equivalent to $B_x p \& B_y p \& B_x B_y p \& B_y B_x p \& \dots$). Note that a one-sided version $BM_{B_{xy} p}$ (equivalent to $B_x p \& B_x B_y p \& B_x B_y B_x p \& \dots$) can be expressed in terms of mutual belief when the 'Closure' axiom and 'Necessitation' rule are assumed:

(5) $BM_{B_{xy} p} \leftrightarrow B_x p \& B_x MB_{xy} p$

The intention operator (I) is introduced, as opposed to 'desire' or 'want', to concentrate on the goal-directed behaviour of the participants in information dialogues. If S intends to do communicative act α , then S has decided to do α , which is clearly not the case with a desire. Bratman (1989) argues that desires can be inconsistent with someone's belief, but that intentions are always assumed to be consistent. He distinguishes two concepts of intention: first, to characterize an agent's actions, and second, to characterize an agent's mental state. In our framework, intention should be considered as the decision of an agent to achieve a certain state of affairs, and can thus be seen as a description of an agent's mental state (namely the intended state).

We will assume that a rational agent does not intend to do superfluous acts. In other words, if an agent intends to achieve a situation in which p

is true, he does not believe that p is already true. The axiom expressing this (BI1) can be seen as an extreme form of Allwood's principle of adequacy: "Try to act as adequately and efficiently as possible to achieve your intended purpose" (Allwood (1976): pp. 49). It would be very inadequate of an agent if he tried to achieve a certain goal which he believed has already been achieved.

Also, intentions are supposed to be consistent with the agent's belief; so, if the agent intends to achieve a situation in which p is true and he believes that from p follows q he does not intend to achieve a situation in which q is not true (BI2). Intentions and belief are related in the following axioms:

- BI1 $\vdash I_x p \rightarrow \neg B_x p$
 BI2 $\vdash I_x p \& B_x (p \rightarrow q) \rightarrow \neg I_x \neg q$
 BI3 $\vdash I_x p \rightarrow B_x I_x p$
 BI4 $\vdash \neg I_x p \rightarrow B_x \neg I_x p$

BI3 and BI4 are added to express the agent's introspective view on his intentions. Moreover, we will assume that if the agent intends to achieve a situation in which p is true and intends to achieve a situation in which q is true, this equals the agent's intention to achieve a situation in which both p and q are true.

- I1 $\vdash I_x p \& I_x q \leftrightarrow I_x (p \& q)$

Note that by means of rule BI2, an agent will never intend both p and $\neg p$ ($I_x p \& B_x (p \rightarrow p) \rightarrow \neg I_x \neg p$).

Now, let us define how the linguistic features of the communicative act should be built into the framework. By considering CAs as special instances of actions, the performance by x of the communicative act CA can be expressed as $DO_x(CA)$. In line with Bunt (1989a) a CA will be viewed as a communicative function (CF) applied to a semantic content (cont). To avoid unnecessary complexity, the semantic content will be restricted here to propositions only.

(6) CA : Application(fun: CF, arg: cont)⁴

⁴The notation is taken from Bunt (1985) and is principally used to show the internal structure of the expression.

where p is the proposition that John is drunk, represented, for example, by $\exists_x(Drunk'(x) \& x = John')$. Below, a shorthand notation will be used. For instance, (9) will be represented as:

$$(10) \quad DO_S(< dec, so[+], final[-], p >)$$

6.3.2 Perrault's theory of defaults and speech acts

In Perrault (1989) a default logic (due to Reiter (1980)) is introduced to specify speech act consequences. Consequences from an utterance can be inferred only as long as they do not contradict the context of the utterance. If, for instance, a speaker utters a declarative with content p then the hearer can come to believe that p is true as long as he cannot find any proof for the contrary (e.g., the hearer believes not p at the moment of uttering, or the hearer believes that the speaker is lying or ironical). An advantage of this approach is that consequences can be inferred without having to specify all the possible (counter-)arguments.

A default theory consists of a set of default rules D and a set of assumptions W of well-formed formulas (for instance, in our language L). Perrault uses so-called *normal* default rules only, which are of the form:

$$\frac{p:Mq}{q}$$

where p is the *prerequisite* and q the *consequent* of the rule, ' Mq ' expresses that q is possible given a certain set of beliefs. Normal defaults are abbreviated as $p \Rightarrow q$, and intended to mean that if p is believed, q is believed as long as q is consistent with what is believed. Default rules should be seen as rules of inference, like Modus Ponens, rather than axioms. The closure of a default theory is called an *extension* and contains: 1. the assumptions W , 2. the closure under logical consequence, and 3. the consequents of the default rules as long as the extension does not contain the negation of the consequent. (For more details, see Reiter (1980).)

A temporal aspect is added to propositional attitudes; for instance, $B_{x,t}p$ means that x believes p at time t . The addition of time motivates two new axioms expressing that agents remember their beliefs over time (Memory) and continue to hold them (Persistence).

Persistence $\vdash B_{x,t+1}B_{x,t}p \rightarrow B_{x,t+1}p$

Memory $\vdash B_{x,t}p \rightarrow B_{x,t+1}B_{x,t}p$

The notion of communication is explicitly built into the ‘Observability’ axiom expressing that if agent y performed an action α and another agent x was observing y , x believes that y was performing the act.

Observability $\vdash DO_{y,t}\alpha \& DO_{x,t}OBS(y) \rightarrow B_{x,t+1}DO_{y,t}\alpha$

Formally, x and y need not be different; however, communication is only achieved when x and y differ. The axiom is oversimplified because agents rather than actions are observed. This is of no concern here.

Perrault also suggests two default rules. Belief from another agent will be taken over as long as this new belief is consistent with the ones already held (Belief transfer), and the content of a declarative utterance is believed to be true (Declarative rule).

Belief transfer $B_{x,t}B_{y,t}p \Rightarrow B_{x,t}p$

Declarative rule $DO_{x,t}p. \Rightarrow B_{x,t}p$

Here $p.$ is the action of uttering a declarative with content p . Default rules are closed under belief by a meta-rule:

if $p \Rightarrow q$ is a default rule, then so is $B_{x,t}p \Rightarrow B_{x,t}q$

Now, Perrault is able to make predictions for the update of the existing context when the usual preconditions of speech acts do not obtain (e.g., in cases of lies or irony). Important to note is that the context will be updated by inferences based on the utterance and its previous context. For instance, suppose that a speaker S utters a declarative with content p , and a hearer H , who observes S , believes that S is lying. In that case, the default inference from the ‘Declarative rule’ that S believes p will be blocked, since H believes that S believes not p and therefore H will not come to believe that p is the case.

The (non-monotonic) default rules in Perrault’s theory seem to correspond to a formalization of standard pragmatic inferences. In non-monotonic reasoning, inferences can be made without complete knowledge of the circumstances. In a classical monotonic system, we could for instance have the following axiom: $DO_{x,t}p. \& \neg LY(x) \rightarrow B_{x,t}p$, (a speaker

believes the content of an uttered declarative unless he is lying). From this axiom it can only be inferred that the speaker believes p if it is explicitly known that the speaker is not lying. By contrast, in non-monotonic reasoning the consequent can be inferred unless it can be proved that the hearer is lying; therefore, the consequent can be inferred in the absence of any belief about the speaker's lying.

In Appelt & Konolige (1988) an alternative proposal is put forward which replaces Reiter's default logic by an extended version of Moore's autoepistemic logic (Moore (1985)) in which the rules generate hierarchical sets of extensions to incorporate preferences among defaults. We will also use a notion of priority of defaults which differs from Appelt & Konolige's proposal in that priority will be built into the default rules themselves, where Appelt & Konolige build priority into a hierarchical structure of subtheories.

6.4 Mental state and utterance features

In this and the following section we would like to discuss how *linguistic* and *contextual* features of utterances reveal certain aspects of the mental state of the speaker. The following linguistic information will be considered: sentence type, particles and prosodics. Contextual information will be restricted to the belief among the dialogue participants as to who is the expert on the topic of the utterance. This belief plays an essential role in the determination of a declarative as a question.

We will assume that the participants behave rationally and cooperatively. To express this behaviour in our language L , we will formalize the Gricean maxims of 'quality' and 'quantity' (Grice (1975)) using the previously defined axioms and newly introduced default rules. An important advantage of formalizing these maxims is that the FCs of a particular communicative act can be drastically simplified.

It was already discussed that no one-to-one relation has been found between linguistic features and illocutionary acts. The same is true of linguistic features and mental states. For instance, depending on the circumstances, a declarative with content p can be used if the speaker has the intention to let the hearer believe that p is true, or a speaker may have the intention to let the hearer believe that the speaker believes

p , or a speaker may even have the intention to know the value of p .

Here, default rules will play an important role, because they enable us to express that in uttering a declarative a speaker *usually* intends the hearer to believe its content. Only in cases where it can explicitly be proved that this is not the case will this interpretation be rejected. Therefore, we will speak of a *preferred set* of felicity conditions as a mental state description rather than as a *direct* or *indirect interpretation* of a communicative act. Different FCs will be hierarchically linked to the linguistic features of the utterance. Although the preferred set of a simple declarative (i.e., of $DO_S(< dec, nil, nil, p >)$) is closely related to its usual direct interpretation, it is important to note that we do not take the view that less preferred sets have to be considered as indirect (Searle (1975)). Searle calculates the indirect act from the direct one; here, we will see that if a preferred set of FCs is inconsistent with, for instance, prior knowledge, the set is rejected by means of the application of inference rules in a certain order before it is even calculated.

6.4.1 Sentence type and felicity conditions

The question is now which preferred set of FCs can be related to the declarative or interrogative sentence type. Before we try to answer this, let us make two assumptions. Firstly, we will assume that a simple declarative agrees with a statement interpretation and a simple interrogative (i.e., $DO_S(< int, nil, nil, p >)$) with a question interpretation. Secondly, we will assume that in all cases the speaker has the intention that the hearer should believe something: if the utterance is declarative, the speaker intends the hearer to believe the content of the utterance;⁶ if interrogative, the speaker intends the hearer to believe that the speaker wants to know something.

The interrogative case partly agrees with Searle's (1969) FCs on questioning. In this paper, the 'preparatory' condition on questioning, viz. that the speaker does not know the answer, follows from the axiom **IB1**: if x has the intention to make p true, x does not believe that p is true at

⁶This choice is based on results from earlier recorded dialogues where information was exchanged about the arrival and departure times of aircraft and trains (see e.g., Beun & Bunt (1987)). In other situations, it may be preferred that, for instance, the speaker intends the hearer to believe that *the speaker believes that p* .

that moment.

$$(11) \quad I_x p \rightarrow \neg B_x p$$

Now, if x is replaced by S and p by $\bar{B}_S p$, i.e. the speaker has the intention to know the value of p ($I_S \bar{B}_S p$), it follows from (11) that S does not believe that S believes whether p :

$$(12) \quad I_S \bar{B}_S p \rightarrow \neg B_S \bar{B}_S p$$

From the consequence of (12) it can easily be proved by means of the 'belief' axioms that the speaker has no belief about p ($\neg \bar{B}_S p$) and therefore Searle's preparatory condition is superfluous.

Just as in the case of an interrogative (or question) the speaker's ignorance about p can be inferred from aspects of the agent's rational behaviour (axiom **IB1**), the speaker's belief that p is true can be inferred from the Gricean maxim of quality (Grice (1975)) in the case of a declarative. This is expressed in (13): if S has the intention to let H believe that p is true, S believes that p is true by default.

$$(13) \text{ Quality } I_S B_H p \Rightarrow B_S p$$

A derived form of the quantity maxim follows from (11), i.e. a speaker does not transfer information that is already known to the hearer.

$$(14) \text{ Quantity } I_S B_H p \rightarrow \neg B_S B_H p$$

Or, with contraposition, if a speaker believes that the hearer believes p , the speaker will never have the intention to make true that the hearer believes p . Now, the following preferred set of felicity conditions holds in the case of a simple declarative and a simple interrogative:

declarative: $FC_d(p) = I_S B_H p$

interrogative: $FC_i(p) = I_S B_H I_S \bar{B}_S p$

6.4.2 The application of default rules

We will now show how default rules can be applied to determine the transferred package of felicity conditions. In many cases, a crucial role is played by the *priorities* of default rules. We will say that:

Default rule ϕ has priority over rule ψ iff the consequent of ψ can be inferred only in case the consequent of ϕ is false.

For instance, it can easily be verified that rule (15a) has priority over rule (15b) and that both (15a) and (15b) have priority over (15c):

$$(15a) \quad p \Rightarrow q$$

$$(15b) \quad p \& \neg q \Rightarrow r$$

$$(15c) \quad \neg q \& \neg r \Rightarrow m$$

We formulate default rules where the communicative act is represented in the prerequisite of the rule, the preferred package of felicity conditions in the consequent. So, if a speaker utters a simple declarative or interrogative, respectively, it can be inferred by default that the felicity conditions $FC_d(p)$ or $FC_i(p)$ hold.

$$(16) \quad DO_S(< dec, nil, nil, p >) \Rightarrow I_S B_{Hp}$$

$$(17) \quad DO_S(< int, nil, nil, p >) \Rightarrow I_S B_H I_S \overline{B}_{Sp}$$

In the expressions below the following abbreviations will be used:

$$STATE \equiv I_S B_{Hp}$$

$$QUE \equiv I_S B_H I_S \overline{B}_{Sp}$$

Empirically, a 'statement' interpretation of declaratives is preferred; however, a declarative can be used for questioning even without any overt question indicators. In Beun (1989) it was shown that no more than 50% of Dutch declarative questions in spoken dialogues possessed an overt question indicator. Therefore it is desirable to be able to infer both interpretations, with a preference for the statement, i.e. a declarative is interpreted as a statement as long as no evidence exists to the contrary. Only if it can be proved that $\neg I_S B_{Hp}$ can the 'question' function be chosen and only then should the 'statement' interpretation be rejected.

In Beun (1988b), it was shown experimentally that questions in Dutch with a declarative sentence type usually have a verificative function, i.e. apart from the usual felicity conditions of the interrogative ($FC_i(p)$) the speaker intentionally communicates that he suspects that p (WB_{Sp}). Now, the second interpretation of the declarative can be written as:

(16a) $DO_S(< dec, nil, nil, p >) \& \neg STATE \Rightarrow QUE \& I_S B_H W B_{Sp}$

To infer the consequent of (16a) it should explicitly be proved that the speaker does not have the intention to let the hearer believe that p is true, which is always true if the consequent of (16) is rejected. This implies that (16) has priority over (16a).

Depending on the discourse situation other functions may be found as well, for instance, marking a topic change (Springorum (1986)) or showing politeness (Beun (1988b)), although the verificative function is preferred. If the speaker has no suspicion about the content of the declarative question a third default rule could be applied:

(16b) $DO_S(< dec, nil, nil, p >) \& \neg STATE \& \neg I_S B_H W B_{Sp} \Rightarrow QUE$

Again, the consequent of (16b) can be inferred only if the consequents of (16) and (16a) cannot be inferred and therefore the latter have priority.

It is important to note that the inference in (16) cannot be made by ordinary implication. (18) as a replacement is problematic because $\neg QUE$ must explicitly be proved to infer the consequence, which is impossible in most realistic cases.

(18) $DO_S(< dec, nil, nil, p >) \& \neg QUE \rightarrow STATE$

Also (19) is unacceptable, because in all cases STATE would be inferred if the speaker utters a declarative, even if it is already known by the hearer that $\neg STATE$.

(19) $DO_S(< dec, nil, nil, p >) \rightarrow STATE$

6.4.3 Other linguistic features

Final rise

An important feature revealing the question function of a declarative is a final rise in intonation, although not all declaratives with a final rise are meant as questions (Geluykens (1987)). Most declaratives with a final rise can be given a question interpretation; only in those cases where it can be proved that the utterance is not a question will a statement interpretation be selected. This can be expressed by the following default rules:

(20a) $DO_S(< dec, nil, final[+], p >) \Rightarrow QUE \& I_S B_H W B_{Sp}$

(20b) $DO_S(< dec, nil, final[+], p >) \& \neg QUE \Rightarrow STATE$

In this case the meaning of the final rise is expressed in the change of priority of the default rules from statement to question interpretation.

The particle 'dus' ('so')

In Beun (1988a) it was demonstrated that if the Dutch particle *dus* (*so*) was added to an utterance which was interpreted as a statement in the absence of the particle⁷ (no punctuation or prosodic information being available), the addition of the particle turns the utterance interpretation into a question. The presence of the particle therefore turns the priority from statement to question interpretation.

(21a) $DO_S(< dec, dus, nil, p >) \Rightarrow QUE \& I_S B_H W B_{Sp}$

(21b) $DO_S(< dec, dus, nil, p >) \& \neg QUE \Rightarrow STATE$

The meaning of the particle is also hidden in the application of the default rules. A further analysis of *dus* will not be pursued, since our framework is far from sufficient to account properly for the information that can be expressed by the particle.

The particle 'wel'

This example shows how the difference between an accentuated and non-accentuated use of a particle can be expressed in the consequent of the default rules. In Abraham (1984) more than 15 different meanings of the Dutch particle *wel* are described, depending on its use in interrogatives, declaratives, stressed, unstressed and so on. A subset will be selected and adapted to the framework here.

A speaker indicates intentionally in a declarative sentence with accentuated *wel* and final fall, in addition to his belief concerning the proposition *p*, the belief that the hearer believes not *p*:

(22a) $DO_S(< dec, wel[+], final[-], p >) \Rightarrow STATE \& I_S B_H B_S B_H \neg p$

⁷Actually, 'statement' is a simplification. The subjects were asked to decide whether the utterance was a question or an answer. Hence, 'statement' agrees with an 'answer' interpretation.

If a final rise is present in the utterance, the utterance gets a question interpretation. The speaker adds intentionally to QUE his belief that the hearer believes that p is true, that the speaker has a weak belief that p is true and that the speaker believed before that not p . (To indicate the latter proposition we will use the expression $Before(B_S \neg p)$.⁸)

$$(22b) \quad DO_S(< dec, wel[+], final[+], p >) \Rightarrow QUE \& \\ I_S B_H (B_S B_H p \& \\ W B_S p \& \\ Before(B_S \neg p))$$

In this case the difference in the interpretations of the interrogative and declarative sentence type is too subtle to represent in our framework. Therefore, both interpretations are considered as being equal:

$$(22c) \quad DO_S(< int, wel[+], final[+], p >) \Rightarrow QUE \& \\ I_S B_H (B_S B_H p \& \\ W B_S p \& \\ Before(B_S \neg p))$$

If the particle is not accentuated in the interrogative case, the speaker adds to QUE that the speaker suspects that not p and that the speaker believed before that p is true.

$$(22d) \quad DO_S(< int, wel[-], final[+], p >) \Rightarrow QUE \& \\ I_S B_H (B_S B_H p \& \\ W B_S \neg p \& \\ Before(B_S p))$$

In this connection a note should be made on the use of particles. In some cases a particle indicates how the proposition should be interpreted in a certain universe of discourse (so-called *sentence* particles; see van de Auwera & Vandeweghe (1984)); in other cases a particle focusses on certain aspects of the proposition (*focus* particles). In this section we concentrated on the first, i.e. on particles that concern the whole proposition. Focus particles change the proposition and one has to take the logical form of the proposition into account to obtain the result of the

⁸ A more extensive treatment of temporal aspects is desirable, but this is beyond the scope of this paper.

added particle. For instance, 'too' in "John is drunk too" may indicate that, besides John, there is someone else who is drunk. In this case the particle does not influence the attitude towards the proposition but the proposition itself, and it would therefore be incorrect to place it in the communicative function.

6.5 Communicative effects and the influence of context

In the previous section we have linked the utterance features to a speaker's mental state by means of default rules and with that, we have indirectly defined the felicity conditions that should be fulfilled to perform a particular linguistic act. From the observation of the act a recipient is able to determine these conditions. So far, however, nothing has been said about the influence of contextual information and the communicative effects on the mental states of both dialogue partners after the performance of the act. In describing these effects we will use Perrault's 'observability' axiom, so that communication is explicitly built into the axioms.

6.5.1 The addition of time

The introduction of temporal aspects in the observability axiom is inevitable, since the omission would lead to unintentional blocking of certain default consequents. Suppose, for instance, that the two agents S and H mutually observe themselves and each other and that S utters a simple declarative. If time were not built in, this would result, among other inferences, in the following:

$$(23) \quad DO_S OBS(H) \& DO_H OBS(S) \rightarrow B_H DO_S OBS(H) \& B_S DO_H OBS(S)$$

$$(24) \quad DO_S(< dec, nil, nil, p >) \& DO_S OBS(S) \rightarrow B_S DO_S(< dec, nil, nil, p >)$$

From the consequent of (24) and the second conjunct of the consequent of (23) it can be inferred by default that $B_S B_H p$.⁹ From the consequent

⁹In the derivation the 'belief transfer' rule is applied.

of (24) it can also be inferred that $B_S I_S B_{Hp}$. Now the default rule of 'quantity' commits us to the default inference that if the speaker intends to let the hearer believe that p is true ($I_S B_{Hp}$), the speaker believes that the hearer does not believe that p is true ($B_S \neg B_{Hp}$), which is inconsistent with the inference that the speaker believes that the hearer believes that p is true ($B_S B_{Hp}$). Because of the inconsistency some of the default inferences will be blocked, although intuitively both inferences are true, except that ' $B_S \neg B_{Hp}$ ' comes *before* the performance of the communicative act and ' $B_S B_{Hp}$ ' *after*. In other words, *context has changed* and therefore the previous and the new state should be carefully separated.

Temporal aspects were already built into Perrault's framework by adding time indices to the formulas. Here, the inclusion of time-dependent states commits us to adjustments of the FCs, since agents behave rationally (and therefore believe in causality) and they do not intend to achieve states which they believe are impossible to achieve (Bratman (1989)). Hence, agents do not believe that the effects of their acts will appear before the acts have been performed.

Here, time t_0 is defined as the time point just before the communicative act and t_1 is the point just after the act.¹⁰ $DO_{x,t_0}\alpha$ means that x started to perform act α at time t_0 and finished the act at time t_1 . So, the length of the interval between t_0 and t_1 depends on the duration of the communicative act. In the case of a declarative with content p , the speaker does not intend that the hearer believes p before the act is finished, i.e. before time t_1 . Also, in case of an interrogative, it can never be the intention of the speaker to believe p before t_2 , since the hearer can only give the answer after time t_1 . This results in the following adjustments of the felicity conditions of the simple declarative and the simple interrogative:

declarative: $FC_{d,t_0}(p) = I_{S,t_0} B_{H,t_1} p$

interrogative: $FC_{i,t_0}(p) = I_{S,t_0} B_{H,t_1} I_{S,t_0} \bar{B}_{S,t_2} p$

By means of the 'observability' axiom, it can be inferred that, if a speaker performs act CA at time t_0 and is observed by the hearer, the hearer believes that the speaker did so:

¹⁰It should be stressed, however, that the time indices in our framework are primarily meant to distinguish different states and are far from sufficient to describe precisely the temporal structure of the actions and the resulting effects as they take place during a dialogue.

$$(25) \quad DO_{S,t_0}(CA) \& DO_{H,t_0}OBS(S) \rightarrow B_{H,t_1}DO_{S,t_0}(CA)$$

By means of the closure rule for defaults it can be inferred from the consequence of (25) that the hearer believes (by default) at time t_1 that the felicity conditions were fulfilled at time t_0 : $B_{H,t_1}FC_{CA,t_0}(p)$. If mutual observability is assumed the extension contains, among other inferences, the mutual belief by S and H at time t_1 that the felicity conditions hold: $MB_{S,H,t_1}FC_{CA,t_0}(p)$. (See Perrault (1989) for a more extensive discussion on how these inferences are derived.)

6.5.2 The influence of contextual knowledge

In this subsection we will concentrate on an example where a simple declarative is interpreted as a question under the influence of contextual features.

In Beun (1988a) it was discussed that (26) is an important consideration in determining whether a declarative utterance U was used as a question.

$$(26) \quad MB_{S,H}Expert_H(topic(U))$$

That is, it is mutually believed by speaker S and hearer H that H is the expert on the topic of the utterance. It was experimentally verified that utterances which fulfill these conditions (like "You want to go by plane" or "You know what time it is") are usually interpreted as questions. A precise definition of the notions 'expert' and 'topic' was omitted and will also be left out in this paper. One can imagine, however, a natural language machine which has to supply information about arrival times of aircraft, which is instructed that it is mutually believed that the machine is the expert about its data base, and where the topic of the data base is the arrival times of aircraft.

The following axiom expresses that if a speaker performs a simple declarative and it is mutually believed that the hearer is the expert on the propositional content p of the declarative,¹¹ then it is not the intention of the speaker that the hearer believes that p is true.

¹¹For reasons of simplicity, we will assume that the hearer is the expert on the content p of the utterance U, and not, as indicated in (26), the expert on the topic of U.

$$(27) \quad MB_{S,H,t_0} Expert_H(topic(p)) \& DO_{S,t_0}(< dec, nil, nil, p >) \rightarrow \neg I_{S,t_0} B_{H,t_1} p$$

Now, suppose that it is initially believed that S and H observe each other and that the hearer believes that it is mutually believed that the hearer is the expert on the proposition p (the first conjunct of (27)). If a speaker utters a simple declarative with content p (the second conjunct of (27)), it can be inferred that the speaker does not intend the hearer to believe that p is true (the consequence of (27)). Since the default consequent of (28) will be rejected, a less preferred interpretation will be chosen, namely the verification interpretation in (29):

$$(28) \quad DO_{S,t_0}(< dec, nil, nil, p >) \Rightarrow I_{S,t_0} B_{H,t_1} p$$

$$(29) \quad DO_{S,t_0}(< dec, nil, nil, p >) \& \neg I_{S,t_0} B_{H,t_1} p \Rightarrow I_{S,t_0} B_{H,t_1} (I_{S,t_0} \bar{B}_{S,t_2} p \& W B_{S,t_0} p)$$

6.6 Discussion

The main problem to be solved in this paper was to find a formalism for describing how linguistic features of utterances could transfer information about a speaker's mental state to a recipient. Therefore an utterance was taken as a communicative act which figures in a framework of default rules. In line with Bunt (1989a) the communicative act was defined as the application of a communicative function to a propositional content. The communicative function consisted of those features that contributed to revealing a speaker's attitudes towards the content of the utterance. Bunt's theory and the one presented in this paper are aimed at different problems, though.

Our view concerns an identification problem; Bunt attempts to define communicative acts as changes in the mental state of both speaker and hearer and formalizes the act as a function from context to context, in terms of the felicity conditions of the act and the update function. In this paper, the communicative act is denoted by an utterance with certain features (and propositional content). The felicity conditions follow by default from the utterance and, from this, a hearer can infer the attitudes which are responsible for the performance of the CA. Bunt's

update function would follow from the closure of the axioms and default rules. Note that both views can lead to the same inferences, since in both cases it was derived that the agents mutually believe that the felicity conditions hold. In our case this is explicitly achieved by means of the observability axiom.

The framework presented here differs slightly from Perrault (1989) too. Perrault's default rules on intention explicitly state that actions are performed intentionally (30) and that if the utterance of a simple declarative is performed intentionally, the speaker believes the content of the utterance (31):

$$(30) \quad DO_{S,t}\alpha \Rightarrow I_{S,t}DO_{S,t}\alpha$$

$$(31) \quad I_{S,t}DO_{S,t}(< dec, nil, nil, p >) \Rightarrow B_{S,t}p$$

In our case, however, from uttering a declarative it can be inferred that the speaker had the intention that the hearer would believe that p is true (32) and from the quality maxim the speaker's belief that p can be derived (33):

$$(32) \quad DO_{S,t}(< dec, nil, nil, p >) \Rightarrow I_{S,t}B_{H,t+1}p$$

$$(33) \quad I_{S,t}B_{H,t+1}p \Rightarrow B_{S,t}p$$

The difference, we think, comes mainly from a different view on the intention operator. In this paper, the operator expresses a certain state the speaker wants to achieve: "The speaker intends to make p true". From the decision by the speaker that a certain state should be reached it follows that the speaker is committed to do certain actions, and every action poses its own problems. For instance, if the speaker intends the hearer to believe that p is true, the speaker may decide to perform intentionally a declarative with content p . This commits the speaker to formulate a certain sentence and to do so a speaker should pick up a pen or open his mouth, etc. In other words, a great deal of intended, parallel and sequential actions are involved to achieve the primary intention.

In this paper, we also left out Perrault's closure rule for intention, i.e:

$$(34) \quad I_{x,t}p \& B_{x,t}(p \rightarrow q) \rightarrow I_{x,t}q$$

The reason for this is given in Cohen & Levesque (1989a): an agent who decides to get his tooth filled and believes that the dentist's action will cause pain, may surely deny that he *intends* to be in a state of having pain. In other words, the agent need not intend all the expected side-effects of his intentions. In our proposal, we have opted for a weaker form of the consequence (i.e., $\neg I_{x,t} \neg q$), and from this it follows that intentions are always consistent.

The advantage using a non-monotonic system is that inferences can be drawn without complete knowledge of the actual state of affairs. Here, the particular choice of the non-monotonic system (Reiter's (1980) default logic) is rather arbitrary; one might as well choose other systems like Moore's (1985) autoepistemic logic or Appelt and Konolige's (1988) hierarchic autoepistemic logic. The latter is more complex and probably too powerful for our case, since non-monotonic rules like $P(a) \Rightarrow \neg F(a)$ and $B(a) \Rightarrow F(a)$ can be given different priorities, which is impossible in our framework and which seems unnecessary. In our proposal, priority is achieved by means of a dependency between the consequent of the preferred rule and the prerequisite of a less preferred rule and thus explicitly built into the rules themselves. In Appelt & Konolige's system the hierarchy is stipulated outside the rules.

In some cases, building in rules of priority can be problematic. Here, we have decided to give priority to the direct use of declaratives and interrogatives as statements and questions, respectively, but one should be aware that in different situations different priorities could be in force. Ambiguities, on the other hand, can simply be incorporated as disjunctions into the consequents of the default rules. Later on, one might hope, the disjuncts can be disambiguated if more knowledge becomes available in the course of the dialogue. It is unacceptable, however, for a system to generate a question interpretation of a declarative on the same level as a statement interpretation simply because both interpretations are possible. Therefore, we have avoided ambiguity by the priority of certain default rules. An advantage is that not all interpretations have to be calculated before one is selected.

This brings us to another subject, namely the use of indirections. Usu-

ally, indirect speech acts are inferred from the direct one and added to the direct one. For example, a declarative question has the direct force of a statement and the indirect force of a question. The literal force hypothesis (LFH) (see Gazdar (1981)) is fully based on the use of explicit performatives and sentence type, as if no other sentence feature, such as particles and intonation, would influence the determination of a speech act type. Our theory can be considered as an extended version of the literal force hypothesis, except that the literal force is not calculated whenever evidence exists to the contrary. Note also that if in the case of LFH a statement is counted as a direct interpretation with a question as an indirect interpretation, both interpretations could lead to contradictory results if they were treated 'on the same level'. For instance, on the basis of $I_S B_{HP}$ we may infer that the speaker believes that p ; on the basis of $I_S B_H I_S \bar{B}_{Sp}$, however, we may infer that the speaker does not believe that p .

As we have seen, contextual knowledge may influence the choice of a certain interpretation. In our theory a declarative was interpreted by the hearer as a question because speaker and hearer mutually believed that the hearer was the expert on the topic, although no information about the question function was available in the utterance itself. This agrees nicely with the results obtained from our experimental and empirical studies of natural dialogues (Beun (1988b) and Beun (1989)) where 50% of the declarative questions have no overt question indicator.

Another result to be mentioned is that the difference between illocutionary and perlocutionary effects becomes indistinct. Levinson (1983) describes illocutionary acts as "what is directly achieved by the conventional force associated with the issuance of a certain kind of utterance in accord with a conventional procedure. In contrast, a perlocutionary act is specific to the circumstances of issuance ... and includes all those effects that some particular utterance in some particular situation may cause" (pp. 237). Here the illocutionary act is replaced by uttering a sentence with particular characteristics, and disconnected from the performative verbs. Both the illocutionary act and the utterance of a sentence with particular characteristics can only be performed if a speaker fulfills certain conditions. Hence, the performance of an illocutionary act is also

specific to the circumstances of the utterance, just as perlocutionary acts are. Clearly, an illocutionary act should be described from a speaker's point of view. Recognition of the act by the recipient in terms of performative verbs is unnecessary for determining the relevant aspects of the speaker's mental state. A recipient has to know how the utterance features can be related to a package of felicity conditions. Since all effects are contextually dependent on what the hearer thinks about the world, about the speaker, and so on, it can be argued that all effects are perlocutionary.

6.7 Conclusion

In this paper, the performance of an utterance is taken as a communicative act to influence certain aspects of the mental state of a hearer. To describe the effects that result from the act, communicative acts were expressed in terms of the linguistic features of the utterance and, by means of default rules, directly connected to the felicity conditions of the act. The felicity conditions were expressed in terms of the speaker's intentions and beliefs that must be present before the act can be performed. Successful communication is accomplished if a hearer recognizes the felicity conditions from the speaker's act, which occurs when the hearer observes the speaker and knows the conventional relation between the utterance features and its felicity conditions.

Default rules were used to build in contextual dependency of the interpretation of the act and to let the agent draw inferences without complete knowledge of the situation. To indicate that a particular interpretation of a communicative act has a preference in most situations, default rules were hierarchically ordered.

To simplify the felicity conditions that are transferred by a particular communicative act, aspects of rationality and cooperation were axiomatized in terms of beliefs and intentions of an agent. Pragmatic principles, such as the Gricean maxim of quality, were expressed in default rules, so that contextual dependency could be incorporated.

An advantage of our approach is that speech acts can be viewed as actions in general, intentionally performed with the aim of changing a certain state (here, the mental state of the dialogue participants). In

this respect, the agent's intentions may be viewed as his commitment to achieve another state by performing a particular action.

There is still a great deal to be done, however. Some of the axioms are oversimplified and in most cases particles and intonation can hardly be interpreted in matters of belief and intention only. Also, the addition of temporal or sequential aspects cannot be avoided in a framework of actions. The most important problem to be solved, we think, is the determination of the primary intention of the speaker, since in the formalism this intention is hidden in an infinite amount of intentions and beliefs that result from the closure of the axioms and default rules. Here, the introduction of a plan-based analysis cannot be avoided.

Chapter 7

Conclusions

The central goal in this thesis was to understand how a declarative can be recognized to have a question function and to identify the information that is communicated by a declarative question (DQ). Let us first summarize the main results and subsequently indicate some limitations of the research.

7.1 Main findings

In spoken information dialogues, almost 20% of the questions is uttered with a declarative sentence type instead of an interrogative one. To indicate the question function of the declarative, a speaker may add two types of indicators to the utterance: prosodic and textual indicators. An important prosodic indicator is a rise in intonation at the end of the utterance. However, since only half of the DQs possesses a rising intonation, the indicator is insufficient to identify all DQs. If a rising intonation is absent, the indicators may come from textual characteristics. Textual question indicators can be divided into two categories:

1. indicators determining that the hearer is the expert on the topic of the utterance.
2. indicators expressing conflicting beliefs between the hearer and speaker, and/or surprise on the part of the speaker about the proposition involved.

Although these indicators may provide strong evidence that the declarative is a question, none is decisive. In all cases the indicators can be overruled by the circumstances of the utterance.

In using a declarative as a question, speakers often indicate that they have a supposition or weak belief about the content of the utterance. This belief may emanate from the discourse itself, from contextual information outside the dialogue, or both. A declarative form is preferred if the information about the content has been literally provided in the dialogue or if the information can be derived by implication; preference decreases if the information is derivable from conversational principles. An interrogative form is preferred if no information about the content is provided in the preceding discourse. The use of declaratives correlates with the certainty of the speaker about the content, although it cannot be concluded that a strong supposition automatically causes a declarative form and a weak or no supposition an interrogative form. The use of declaratives decreases when topical shifts or changes occur; moreover, for reasons of politeness it happens that a declarative is used even when there is hardly any evidence about the content.

We have argued that a DQ without prosodic and textual question indicators does not have to be interpreted as an indirect use of a statement, but rather as a choice for a less preferred interpretation induced by contextual knowledge. Beliefs and intentions of the speaker were derived directly from the linguistic features of the utterance and not through the determination of an illocutionary force.

7.2 Limitations and future research

Prosodics

Our data used in the experiments in chapter 3 were limited to utterances without a final rise. Although a final rise in Dutch strongly indicates the question function of a declarative, it is still indefinite whether it is sufficient to conclude that the declarative is used as a question. Geluykens (1987) already showed that English utterances in isolation with a final rise are not always interpreted as questions. A major problem in his results is, however, that he used intonation patterns that were synthesized and we are ignorant about the correspondence of these patterns and perceptually relevant patterns in natural dialogues. A solution to this problem could be to investigate all utterances with a final rise in a representative corpus of dialogues and see whether they function as

questions. We did not investigate this systematically, but it appears intuitively obvious that, apart from the DQs, other utterances occur with a final rise. In that case, it should be investigated whether a combination of other characteristics, such as declination and accentuation, may distinguish DQs from other utterances. Another point of investigation might be the slope of the final rise in DQs, which is probably different from that in other utterances. An indication that other relevant prosodic features are present as well follows from the experimental results in chapters 3 and 4. From Figure 3.2 we have concluded that a substantial part of the utterances without textual indicators and without a rising intonation is interpreted as questions. In chapter 4 only a small part of the utterances without textual indicators was identified as questions (Figure 4.2). So, since contextual indicators were absent in these experiments, other prosodic indicators than a rising intonation must be involved.

Particles

Although particles are widely used in spoken dialogues,¹ until recently their semantic descriptions have almost completely been neglected by linguists. One of the reasons was a lack of tools to account for a satisfactory description (see e.g., Wierzbicka (1986)). To describe the semantics of the particles in this thesis, we have used a framework of belief and intention, with ordered default rules to express the shift of the subjects' preference between a statement and a question interpretation. It should be noted, though, that our semantic descriptions are considerably limited and that we have concentrated on a few particles only. It is to be expected that a more detailed treatment and further experiments would explain *why* some of these particles support a question interpretation. Undoubtedly, concepts like topical development, dialogue structure, distribution of knowledge, etc., should be incorporated in the analysis; also a more sophisticated treatment of temporal aspects should be undertaken. For instance, it was found that sentences with particles that express conflicting beliefs are more often interpreted as questions. If agents act rationally and cooperatively, then they will avoid contradictions and conflicts, and try to determine the reason for contradicting propositions

¹In contrast with other languages such as Dutch, German and Russian, the role of particles in English is rather modest.

in order to solve a conflict. Hence, conflicting beliefs evoke 'special' responses and therefore the particles under consideration may have a more question-like interpretation.

The type of dialogue

Another restriction is that we have concentrated on a small part of language use: the use of utterances in Dutch informative telephone dialogues. The restriction to information dialogues prevents us from modelling, for instance, social status or emotion, and the restriction to telephone dialogues excludes non-verbal aspects of communication. It is to be expected that, in face to face dialogues, gesticulation, facial expressions, and eye and body movement will play an important role in the identification of intentions and beliefs. We have avoided this for obvious reasons; the multimodal aspect would have increased the complexity of the dialogue dramatically. Moreover, it is not likely that computers will be able to perceive and recognize such behaviour in the near future.

The function of declarative questions

In this thesis it was found that speakers often use a declarative for questioning if they have a weak belief about the content. But, if a speaker wants to know the answer, why then does he also want to express such a belief? In other words, what effect do speakers want to have on the hearer's mental state by expressing their weak belief? In chapter 5, it was found that DQ's are often used when the information is literally provided in the dialogue or can be derived by implication or implicature from one or more previous utterances. This implies that the speaker is aware that the hearer knows that the speaker has evidence about the content of the DQ. So, if speakers do not express this evidence, they give the impression that relevant parts of the discourse were not well understood. Note also that in normal circumstances it is considered inattentive to repeat the same question in an interrogative form if the question was already answered. So, although it was argued that the Gricean maxim of quantity was exploited by using a DQ (e.g., chapter 5: 'the hearer already knows the content of the utterance'), the maxim seems to be adhered to at some deeper level to prevent the hearer from thinking that

certain parts of the discourse were misunderstood. In this respect, the DQ seems to fulfill the control function of an acknowledgement.

7.3 Concluding remarks

In this thesis we have used empirical and experimental results to support a better understanding of certain speech acts. With that, we have attempted to contribute to a more integrative theory of natural language understanding based on an analysis of what people actually do in conversations and on results from philosophically and computationally oriented traditions. It is our opinion that conversational analysis and speech act theory should be seen as *supplementary* rather than *competing* approaches to discourse processing. To make accurate observations possible, we also believe that the two disciplines cannot do without controlled experiments; in this respect, our experimental results may be conceived as an intermediary between the two approaches.

We do not believe that a well-founded semantic description of illocutionary acts constitutes a goal in language understanding. This is motivated by the results from chapter 6 where linguistic characteristics of the utterance were mapped directly on an intentional framework, and where illocutionary categorization was omitted because it was superfluous. As far as conversational structure is concerned, it is our opinion that speech act theory mainly contributes to the idea that language use can be conceived as the performance of actions, and therefore should be considered part of a more general theory of planning and acting.

Clearly, a lot remains to be done. For instance, in the theoretical framework sketched in chapter 6, the conception of time as subsequent states precludes the representation of continuous and parallel events. Also, the framework does not explain *why* people are committed to achieve a certain state, and also we are unable to express the strength of the agent's commitment and belief.² It is readily agreed that such aspects should be included in a model of natural language understanding, but this would have far-reaching consequences from a formal and computational point of view.

²We have included a 'weak belief' operator, though, to account for at least two different strengths of belief.

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Summary

This thesis presents a study concerning the identification in dialogues of questions with a declarative sentence type (DQs). The type of dialogue is restricted to information dialogues, i.e. dialogues with the sole purpose of transferring factual information.

In chapter 2 a general introduction is given on the identification of communicative acts and speech acts in particular. Speech acts are considered as a special instance of communicative acts, namely those acts that are intentionally meant to transfer certain linguistic information.

In previous experiments telephone dialogues were recorded between an informant from Amsterdam airport and an information seeker. It was found that almost 20% of the questions possessed the syntactic form of a declarative. Half of these utterances had a rising intonation in the end as a question indicator.

To recover other (prosodic or textual) indicators in the utterances three experiments were carried out in which subjects had to determine the question function from utterances in isolation. In chapter 3, two experiments are described where the utterances were presented on tape; in chapter 4, an experiment is described where the utterances were presented on screen.

The first experiment described in chapter 3 was an exploratory investigation to find out the main question indicators in spoken DQs. DQs and answers were isolated from the original dialogues and presented to the subjects on tape. The subjects' task was divided into two parts: in one part they had to indicate whether the utterance was a question or not, in the other they had to indicate whether the utterance was an answer or not. It was found that subjects mainly indicated a question function when the utterance contained particles such as *en* (*and*), *du* (*so*) and *ook* (*also*). The second experiment was carried out to verify whether these particles or (unknown) prosodic features contributed to a question interpretation. Potential linguistic indicators were removed from the utterances which were presented to the subjects together with the original utterances. The task of the subjects was identical to the first experiment. As a result, it followed that the removal of the particles *en* and *oh* at the beginning of the utterance, and the particle *du*

significantly influenced the responses of the subjects. Utterances that contained these particles were more often interpreted as questions than utterances without.

A shortcoming was that the removal of linguistic indicators had the consequence of cutting out both textual and prosodic aspects. To eliminate prosodic characteristics and to concentrate on textual indicators only, an experiment is described in chapter 4 where subjects had to indicate the question function from utterances presented on screen. The task of the subjects was identical with the task in the previous experiments. It was found that two types of indicators were important in the interpretation of a declarative as a question. Firstly, indicators that determine that the hearer is the expert on the topic of the utterance and, secondly, indicators that express conflicting beliefs between the hearer and the speaker and/or surprise of the speaker about a stated proposition. Since, the results were similar to the results in the experiments described in chapter 3, it seemed to be the case that, apart from a rising intonation in the end of the utterance, prosodic indicators play only a limited role in the recognition of a declarative as a question.

In chapter 5 it was investigated what contextual features contributed to the use of a declarative as a syntactic form of a question instead of an interrogative form. Two experiments were carried out in which dialogues, taken from the earlier recorded dialogues, were presented to subjects in printed form. In the first experiment, the preference of subjects was tested for a declarative form or an interrogative one. In the second experiment, subjects had to indicate the degree of certainty of the speaker about the proposition stated in the declarative. Information with respect to the semantic content of the utterance was built into the dialogues in three ways: 1. the information was literally provided in the previous discourse or could be derived by implication from previous utterances, 2. information could be derived from the Gricean principle of cooperation, and 3. the information was not available or could only be derived from already existing world knowledge. It was found that the use of declarative questions was high in the first case and decreased in the second and the third. The same result was found for the certainty about the content of the declarative. Moreover, the outcome was also influenced by an abrupt topic change of the utterance and by rules of politeness. In most cases,

however, where a declarative form is used for questioning, a speaker wants to express a weak belief about the content of the declarative and uses this form to verify a certain statement. It is discussed that in some cases the inference to derive a certain belief is complex, but this is of no concern to the hearer. A hearer has to identify only the question function of the declarative and may take the belief of the speaker for granted.

In chapter 6 a theoretical framework was sketched to identify relevant parts of a speaker's mental state, in terms of beliefs and intentions, from the linguistic features of the utterance. For that, communicative acts were considered as functions that change one context into another and were expressed in observable features of the utterance, such as 'declarative', 'rising intonation', etc. The features of the utterance were directly linked to the necessary conditions (felicity conditions) to perform a certain act. This connection was accomplished by means of default rules, which were hierarchically ordered. The introduction of default rules offered a possibility to include contextual dependency without knowing all the facts. Moreover, by means of the hierarchical order certain indirect speech acts can be considered as a choice for a less preferred set of felicity conditions and other, more preferred sets, can be rejected beforehand on contextual grounds. The framework opens up a possibility to interpret declaratives, without any other indicators, as questions instead of statements. In those cases, evidence must be found that the statement interpretation conflicts with previous contextual knowledge; for instance, when the hearer knows that it is mutually known that the hearer is the expert on the topic of the utterance. The theoretical framework was developed in such a way that many of the results from the experiments could be incorporated qualitatively.

Samenvatting

In dit proefschrift wordt de herkenning behandeld van vragen die een declaratief zinstype bezitten (DQs) in dialogen. Het type dialoog wordt hierbij beperkt tot zogenaamde 'informatie dialogen', dat zijn dialogen waarbij de gesprekspartners slechts als doel hebben feitelijke informatie over te dragen.

Hoofdstuk 2 geeft een algemene introductie over de herkenning van communicatieve handelingen in het algemeen en taalhandelingen in het bijzonder. Taalhandelingen worden hierbij beschouwd als communicatieve handelingen waarbij de spreker intentioneel probeert bepaalde informatie over te dragen met behulp van linguïstische middelen.

In eerder uitgevoerde experimenten zijn telefonische dialogen opgenomen tussen een informatrice van Schiphol en een informatie-opvrager. Hierbij bleek dat bijna 20% van de vragen een declaratief zinstype bezat en dat slechts in de helft van deze gevallen de vraagfunctie werd aangegeven door een finale stijging in de intonatie.

Om andere indicatoren in de uiting te achterhalen (zowel prosodisch als textueel) zijn een drietal experimenten uitgevoerd waarbij de proefpersonen de vraagfunctie moesten bepalen van een aantal declaratieve uitingen in isolatie. In hoofdstuk 3 zijn twee experimenten uitgevoerd waarbij de uitingen op band werden aangeboden; in hoofdstuk 4 werden de uitingen op beeldscherm gepresenteerd.

Het eerste experiment in hoofdstuk 3 was een verkennend onderzoek om de belangrijkste indicatoren in gesproken DQs vast te stellen. Hierbij waren zowel DQs als antwoorden geïsoleerd uit de eerder opgenomen dialogen en op band aangeboden aan de proefpersonen. De opdracht van de proefpersonen bestond uit twee delen: in een deel moesten de proefpersonen aangeven of de uiting een vraag was of niet, in het andere deel of de uiting een antwoord was of niet. Partikels als *en* aan het begin van de uiting, en *dus* en *ook* leken hierbij belangrijke indicatoren te zijn voor de vraagfunctie. In een tweede experiment is geverifieerd of de bijdrage aan de vraagfunctie daadwerkelijk van deze partikels afkomstig was of dat misschien tot dan toe onbekende prosodische factoren een rol zouden spelen. Daartoe werden textuele eigenschappen die een mogelijke bijdrage konden leveren aan de vraagfunctie verwijderd van de

uiting en de nieuw verkregen uitingen werden tesamen aangeboden met de originele uitingen. De proefpersonen hadden dezelfde opdracht als in het voorafgaande experiment. In dit geval bleek dat het verwijderen van de partikels *en* en *oh* aan het begin van de uiting, en het partikel *dus* de responsies van de proefpersonen significant beïnvloedden. Uitingen die deze partikels bevatten werden meer als vragen geïnterpreteerd dan uitingen zonder deze partikels.

Een tekortkoming van het laatstgenoemde experiment was dat door het verwijderen van de textuele indicatoren wellicht eveneens prosodische indicatoren werden verwijderd. Om de invloed van prosodische aspecten na te gaan is een experiment uitgevoerd in hoofdstuk 4, waarbij de proefpersonen de vraagfunctie moesten aangeven van uitingen die op een beeldscherm waren gepresenteerd. In dit geval werden twee belangrijke types indicatoren gevonden die bijdroegen aan de interpretatie van de uiting als vraag. Ten eerste, indicatoren die bepalen dat een hoorder expert is over het onderwerp van de uiting en, ten tweede, indicatoren die conflicten aangeven tussen de kennis van de spreker en de hoorder en/of verbazing uitdrukken van de spreker over een bepaalde propositie. Verder kwamen de verkregen resultaten sterk overeen met de resultaten van de experimenten uit hoofdstuk 3.

In hoofdstuk 5 is onderzocht in hoeverre contextuele factoren een bijdrage leveren aan het gebruik van een declaratief i.p.v. een interrogatief als syntactische eigenschap van een vraag. Hiervoor zijn twee experimenten uitgevoerd waarbij aan proefpersonen relatief korte dialogen op papier werden aangeboden. In het eerste experiment moesten de proefpersonen aangeven welke vorm oorspronkelijk in de dialoog was gebruikt voor het stellen van een vraag: een declaratieve of een interrogatieve vorm. In het tweede experiment moesten de proefpersonen schattingen maken van de graad van zekerheid van de spreker omtrent de propositie die uitgedrukt werd in de declaratief. Daartoe werd informatie met betrekking tot de semantische inhoud van de uiting op drie verschillende manieren in de dialoog ingebouwd: 1. de informatie werd letterlijk in de voorafgaande tekst vermeld of kon m.b.v. implicatie worden afgeleid, 2. de informatie kon worden afgeleid m.b.v. het Griceaanse coöperatie-principe en 3. de informatie was niet beschikbaar in de voorafgaande tekst, maar kon hooguit afgeleid worden m.b.v. reeds

bestaande wereldkennis. Zowel het gebruik van declaratieven als de zekerheid omtrent de inhoud van de uiting was hoog in het eerste geval en daalde in de daaropvolgende gevallen. De resultaten van het experiment werden bovendien beïnvloed door een eventuele onderwerpswisseling in het gesprek en bepaalde beleefdheidsregels. In de meeste gevallen werd een declaratieve vorm voor het stellen van een vraag echter gebruikt om een vermoeden uit te drukken betreffende de inhoud van uiting; de vraag krijgt hierdoor de functie van een verificatie. De inferenties om tot een vermoeden te komen zijn dikwijls bijzonder ingewikkeld, hetgeen echter niet van belang is voor de herkenning van de declaratief als vraag. Een hoorder hoeft slechts de vraagfunctie van de declaratief te identificeren en wanneer dit eenmaal is gelukt kan direct uit de vorm afgeleid worden dat de spreker een vermoeden heeft over de inhoud.

In hoofdstuk 6 is een theoretisch kader ontwikkeld waarbij het mogelijk is relevante delen van de mentale toestand van een spreker (uitgedrukt in termen van kennis en/of intenties van de spreker) te identificeren aan de hand van de linguïstische eigenschappen van de uiting. Communicatieve handelingen worden hierbij beschouwd als functies die een bepaalde context kunnen veranderen in een andere context en worden uitgedrukt in waarneembare eigenschappen van de uiting, zoals 'declaratief', 'finale stijging', etc. De eigenschappen van de uiting zijn hierbij door middel van defaultregels verbonden met de geschiktheidsvoorwaarden voor de uitvoering van een bepaalde handeling. De introductie van defaultregels maakt het mogelijk contextuele afhankelijkheid te introduceren zonder dat alle feiten over de context bekend hoeven te zijn. Verder zijn de defaults zodanig ontworpen dat een volgorde aanwezig was in een aantal verschillende regels. Dit stelt ons in staat om de interpretatie van bepaalde indirecte taalhandelingen te beschouwen als een keuze voor een andere verzameling geschiktheidsvoorwaarden dan die de voorkeur geniet puur op grond van de linguïstische eigenschappen van de uiting. De juiste keuze kan dan gemaakt worden op grond van contextuele eigenschappen van de uiting. Op deze manier kunnen declaratieven louter op grond van contextuele kennis van de hoorder geïnterpreteerd worden als vragen i.p.v. beweringen. Zo'n geval doet zich bijvoorbeeld voor indien de hoorder de kennis bezit dat de spreker en de hoorder wederzijds weten dat de hoorder expert is over het on-

derwerp van de uiting. Het theoretisch kader is zodanig ontwikkeld dat de resultaten van de voorafgaande experimenten er kwalitatief goed in passen.

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